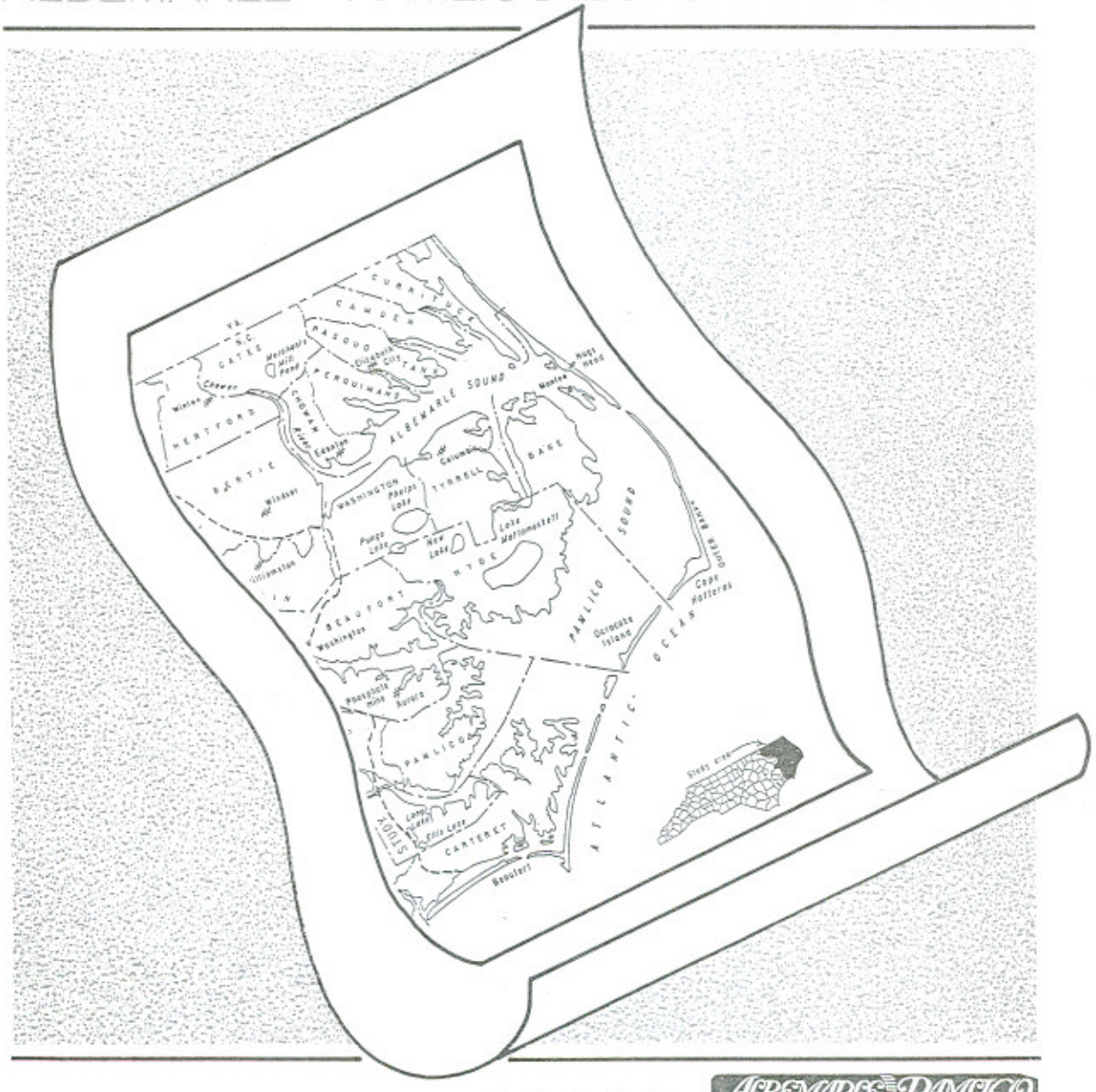
April 1990

Project No. 90-06

DATA MANAGEMENT AND ANALYSIS SYSTEM DATA REQUIREMENTS DOCUMENT

ALBEMARLE - PAMLICO ESTUARINE STUDY



Funding Provided By
North Carolina Department of Natural Resources and Community Development
Environmental Protection Agency National Estuary Program

ALBEMARLE-PAMLICO

ALBEMARLE-PAMLICO ESTUARINE STUDY
DATA MANAGEMENT AND ANALYSIS SYSTEM

DATA REQUIREMENTS DOCUMENT

PREPARED BY:

STATE CENTER FOR GEOGRAPHIC INFORMATION & ANALYSIS (CGIA)

PREPARED FOR:

STATE OF NORTH CAROLINA
DEPARTMENT OF ENVIRONMENT, HEALTH, AND NATURAL RESOURCES
A/P STUDY PROGRAM OFFICE

APRIL 1990

A/P STUDY PUBLICATION NO. 90-06

EXECUTIVE SUMMARY

The State Center for Geographic Information & Analysis (CGIA), formerly Land Resources Information Service (LRIS), conducted a data needs assessment for the Albemarle-Pamlico Estuarine (A/P) Study in the fall of 1988. The purpose of the data needs assessment was to define the data requirements for the A/P Study Database to be implemented under the A/P Study data management program. This data requirements document is one of the products of the data needs assessment effort. Its contents are sufficiently detailed to allow for implementation of a database that is responsive to the data needs expressed by the A/P Study resource management and research communities.

The data needs assessment consisted of a multi-step process to obtain the characteristics of existing data and future data needs. This process started with identification of organizations which could contribute to specification of the A/P Study Database and those who were potential users of the database. Interviews were scheduled and completed with representatives of each organization during the September-November 1988 timeframe. Over 50 interviews were conducted involving over 100 people. Data needs were assembled from notes taken during the interviews, completed questionnaires, and data documentation provided by the interviewees. This set of information was used to identify each data layer required to support A/P Study users and to document their characteristics. A data layer consists of cartographic data and attribute data. The cartographic data were ranked by data acquisition priority; the attribute data were ranked separately using the same method. Priorities were based on two factors: ease of data acquisition and expected utility. The final step in the data needs assessment process was to evaluate the total set of data layers and list of attribute data and to recommend a schedule for data acquisition. Data gaps were also identified during the evaluation (e.g., incomplete geographic coverage, unavailable data layers). Results of the entire data needs assessment effort are included in this report.

Requirements for the A/P Study Database include two major categories of data: data layers that include cartographic data that represent spatial features; attribute data that describe those features with sample, statistical, and/or other tabular information; and bibliographic data that provide references of documented resource management and research activity in the A/P Study region. There were 64 sets of cartographic data identified and ranked for storage in the A/P Study Database. Each set was documented by a narrative description of its status, data source and currency, expected frequency of use, use restrictions, update frequency, data items, and any special data management considerations for the data layer. Some of the most critical cartographic data included were hydrography, land use and land cover, wetlands and

deep water habitats, ambient water quality monitoring sites, and the natural heritage inventory. Table ES-1 lists each set of cartographic data, the status of each, and the estimated completion date. Status and estimated completion date in this context refer to entry into the geographic information system at CGIA.

There were 60 sets of attribute data identified for inclusion in the database. Attribute data were documented with a narrative description, data condition, data source and currency, expected frequency of use, use restrictions, update frequency, data items, and any special data management considerations. Many of the sets of attribute data are directly linked to data layers of the same name. Others are represented by a general level of geography, such as the various permits that are coded by county only. Table ES-2 lists the sets of attribute data, the status of each set, and the estimated completion date. Again, status and completion date refer to entry into the geographic information system at CGIA.

Types of bibliographic data entries were identified to fulfill the third major segment of A/P Study data requirements. These entries are: books, published reports, unpublished reports, published proceedings, journal articles, and databases/data files.

	NAME	STATUS	ESTIMATED DATE OF COMPLETION
1.	State Boundary	Complete	Done
2.	A/P Study Area Boundary	In-Progress	Jun 90
3.	County Boundaries	Complete	Done
4.	Subbasins	In-Progress	Jun 90
5.	Quad-County-Subbasin Boundaries	Planned	Jun 90
6.	Hydrography	In-Progress	Mar 90
7.	Land Use and Land Cover	Planned	Jun 90
8.	Point Source Dischargers	In-Progress	Sep 90
9.	Wetlands and Deep Water Habitats	Planned	No definite milestone
10.	Ambient Water Quality Monitoring Sites	Complete	Done
11.	Natural Heritage Inventory	In-Progress	Sep 90
12.	1980 Census Boundaries	Complete	Done
13.	Surface Water Intakes	Complete	Done
14.	Submerged Aquatic Vegetation	Complete as mapped	Done
15.	Superfund Sites	Planned	Jun 90
16.	1990 Census Boundaries	Planned	Jun 92
17.	Coastal Reserves	In-Progress	Mar 90
18.	Fisheries Biological Monitoring Sites	Complete	Done
19.	Oyster Cultch Plant Sites	Complete	Done
20.	Game Lands	Complete	Done
21.	Heavy Metal and Organic-Rich Mud Poliutants Sample Sites	In-Progress	Done (Pamlico) Sep 90 (Neuse) Sep 92 (Albemarle)
22.	Citizen Water Quality Monitoring Sites	Complete	Done
23.	Mussel Distribution	Complete	Done
24.	Bottom Sediment Sample Locations	Complete	Done
25.	Federal Land Ownership	Complete	Done
26.	Nursery Areas	Complete	Done
27.	Shellfish Evaluation Areas	Complete	Done
28.	Oyster Producing Areas	Complete	Done
29.	Outstanding Resource Waters	Planned	Mar 90
30.	1970 Census Boundaries	Complete	Done
31.	Artificial Reefs	Complete	Done
32.	CAMA Major Development Permits	Planned	Jun 90
33.	General Soils	Complete	Done
34.	Transportation	In-Progress	Jun 90

TABLE ES-1 List of Cartographic Data

	NAME	STATUS	ESTIMATED DATE OF COMPLETION
35.	State Park Boundaries	Complete	Done
36.	Stream-Gaging Stations	Planned	Sep 90
37.	Marinas	Planned	Dec 90
38.	Peat Lands	Complete	Done
39.	Anadromous Fish Areas	Complete	Done
40.	Public Water Supplies (Groundwater Intakes)	Planned	Jun 90
41.	Solid Waste Facilities	Planned	Dec 90
42.	Aquifers	Planned	Sep 90
43.	Detailed Soils	In-Progress	No definite milestone
44.	Municipal Boundaries	Complete	Done
45.	Pollution Incidents	Planned	Sep 90
46.	Ambient Air Monitoring Sites	Planned	Dec 90
47.	Air Quality Permits	Planned	Dec 90
48.	Air Emissions Inventory	Planned	Dec 90
49.	Water Quality Sample Project Locations	Planned	Dec 90
50.	Mining Permits	Planned	Mar 91
51.	Lease Blocks	Complete	Done
52.	Geology	Complete	Done
53.	Geodetic Control Points	Planned	Mar 91
54.	Sea Turtle Population Sites	Planned	Mar 91
55.	Ocean Fishing Pier Licenses	Planned	Mar 91
56.	Military Air Space	Complete	Done
57.	Fishing Water Jurisdictions	Complete	Done
58.	Historic and Archaeological Sites, Buildings, and Structures	Planned	Mar 91
59.	Water Quality Monitoring Sites (Groundwater)	Planned	Jun 91
60.	Water Level Monitoring Sites (Groundwater)	Planned	Jun 91
61.	Dam Inventory	Planned	Jun 91
62.	Elevation	Planned	No definite milestone
63.	Watersheds	Planned	No definite milestone
64.	Bathymetry	Planned	No definite milestone

KEY TO TABLE

Complete = full digital data coverage present for A/P area
In-Progress = A/P-wide coverage does not exist
Planned = none of A/P area present in digital form

TABLE ES-1 List of Cartographic Data (Continued)

	NAME	STATUS	ESTIMATED DATE OF COMPLETION
1.	1970 Census Data	In-Progress	Sep 90
2.	1980 Census Data	Planned	Jun 90
3.	1990 Census Data	Planned	Jun 92
4.	Agricultural Output Statistics	Planned	Sep 90
5.	Air Emissions Inventory Data	Planned	Dec 90
6.	Air Quality Permits Data	Planned	Dec 90
7.	Ambient Air Monitoring Data	Planned	Dec 90
8.	Ambient Water Quality Monitoring Data	In-Progress	Mar 90
9.	Anadromous Fish Data	Complete	Done
10.	Big Game Kill Reports Data	Planned	Sep 90
11.	Boat Registrations Data	Planned	Sep 90
12.	Boating Access Areas Data	Planned	Dec 90
13.	Bottom Sediment Sample Data	Complete	Done
14.	Building Permits Data	Planned	Sep 90
15.	CAMA Major Development Permits Data	Planned	Jun 90
16.	Census of Agriculture	Planned	Sep 90
17.	Census of Manufactures/Mineral Industries	Planned	Sep 90
18.	Census of Wholesale and Retail Trade	Planned	Sep 90
19.	Citizen Water Quality Monitoring Data	In-Progress	Mar 90
20.	Commercial Landings Data	Planned	Sep 90
21.	County Business Patterns Data	Planned	Sep 90
22.	Dam Inventory Data	Planned	Jun 91
23.	Detailed Soils Data	In-Progress	No definite milestone
24.	Fish Processing Operations Data	Planned	Sep 90
25.	Fisheries Biological Monitoring Data	Complete	Done
26.	Furbearer Harvest Data	Planned	Sep 90
27.	General Soils Data	Complete	Done
28.	Hazardous Waste Facilities Data	Planned	Sep 90
29.	Heavy Metal and Organic-Rich Mud Pollutants Data	In-Progress	Done (Pamlico) Sep 90 (Neuse) Sep 92 (Albemarle)
30.	Historic and Archaeological Data	Planned	Mar 91
31.	Marinas Data	Planned	Dec 90
32.	Mechanical Harvest of Clams Permits Data	Planned	Sep 90
33.	Mining Permits Data	Planned	Mar 91
34.	Municipal Data	Complete	Done
35.	Mussel Distribution Data	Planned	Mar 90
36.	Natural Heritage Inventory Data	In-Progress	Sep 90

TABLE ES-2 List of Attribute Data

	NAME	STATUS	ESTIMATED DATE OF COMPLETION
37.	Ocean Fishing Pier Licenses Data	Planned	Mar 91
38.	Operating Unit Survey Data	Planned	Sep 90
39.	Outdoor Recreation Facility Inventory Data	Planned	Sep 90
40.	Oyster Cultch Plant Data	Complete	Done
41.	Oyster, Scallop, and Clam Licenses Data	Planned	Sep 90
42.	Pollution Incidents Data	Planned	Sep 90
43.	Population Estimates/Projections Data	Planned	Sep 90
44.	Pound Net Registrations Data	Planned	Sep 90
45.	Public Water Supplies Data (Groundwater Intakes)	Planned	Jun 90
46.	Recreational Fishery Statistics	Planned	Sep 90
47.	Sea Turtle Population Data	Planned	Mar 91
48.	Seafood Dealer Licenses Data	Planned	Sep 90
49.	Solid Waste Facilities Data	Planned	Dec 90
50.	State Parks Data	Complete	Done
51.	Stream-Gaging Data	Planned	Sep 90
52.	Striped Bass Reproduction Monitoring Data	Planned	Sep 90
53.	Superfund Data	Planned	Jun 90
54.	Surface Water Intakes Data	Complete	Done
55.	Tourism Expenditures and Employment Data	Planned	Sep 90
56.	Vessel Licenses/Permits Data	Planned	Sep 90
57.	Water Level Monitoring Data (Groundwater)	Planned	Jun 91
58.	Water Quality Data Analysis	Planned	Sep90
59.	Water Quality Monitoring Data (Groundwater)	Planned	Jun 91
60.	Water Quality Sample Project Data	Planned	Dec 90

KEY TO TABLE

Complete = full digital data coverage present for A/P area
In-Progress = A/P-wide coverage does not exist
Planned = none of A/P area present in digital form

TABLE ES-2 List of Attribute Data (Continued)

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SECTION 1

INTRODUCTION

1.1 Overview of Albemarle-Pamlico Estuarine Study

The Albemarle-Pamlico Estuarine Study (A/P Study) is a joint effort funded by the Environmental Protection Agency (EPA) and the State of North Carolina. The purpose of the program is to provide scientific knowledge and public awareness about the estuarine environment to foster better resource management decision making in the area. The study area consists of all lands that drain into the Albemarle and Pamlico Sounds, representing approximately 10 million acres in North Carolina and another two million acres in Virginia as shown on the map in Figure 1.

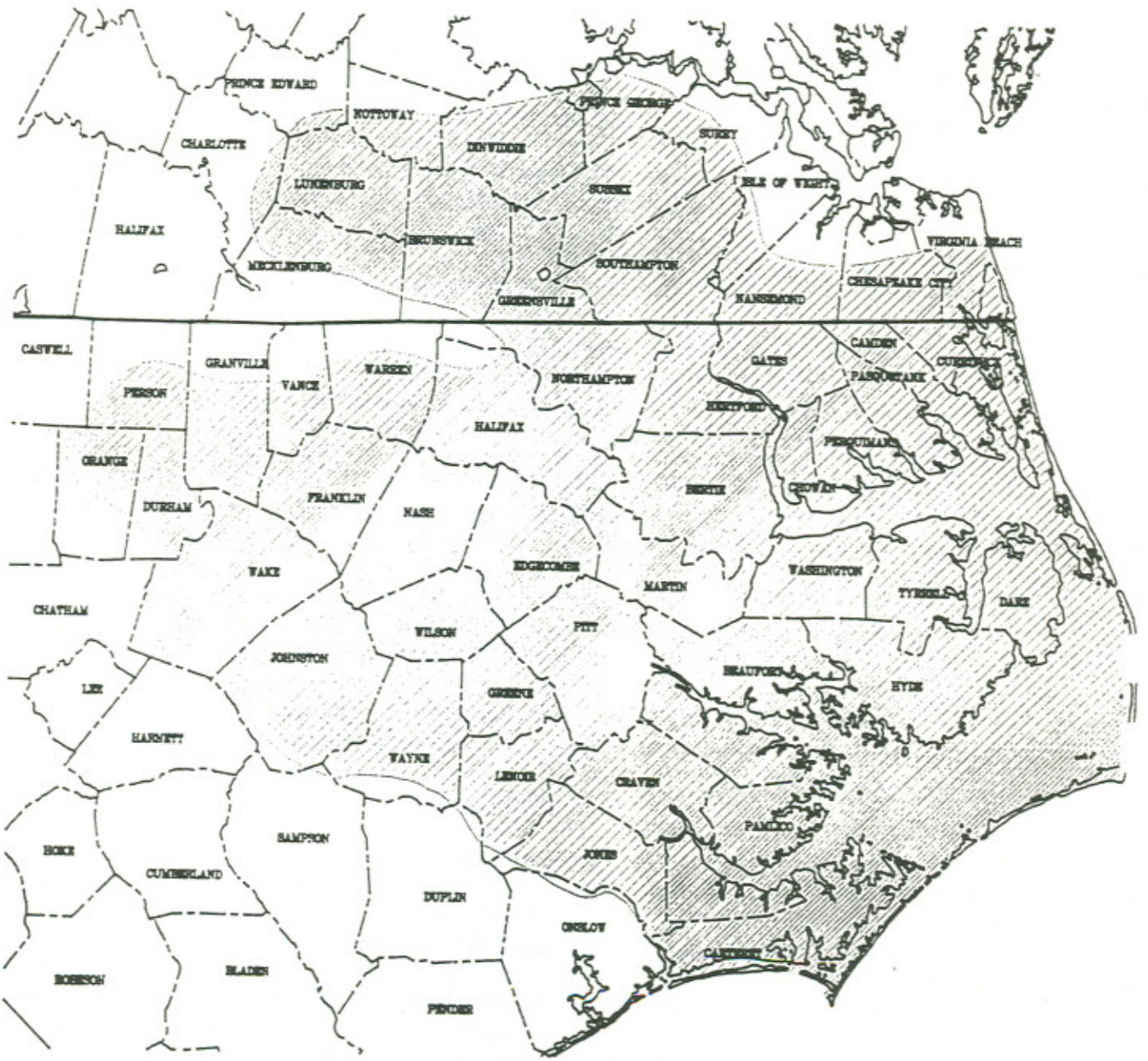
Scientific knowledge and public awareness are necessary to accomplish rational management decision making in the study area at the federal, state, and local levels. Through the A/P Study, a better understanding of the chemical, physical, and biological properties of the estuary and its biological habitat is being generated. From this understanding will come management strategies for restoring and maintaining the area. Upon completion of the five-year program in 1992, the State of North Carolina will have the responsibility of implementing the management strategies developed during the program.

Large amounts of data are produced through the gathering of scientific knowledge about the study area and likewise large data volumes will be used in the process of developing management strategies. The A/P Study data management program was established early in the study to deal with the data from researchers as well as resource managers. The State Center for Geographic Information & Analysis (CGIA), an agency of DEHNR and formerly known as Land Resources Information Service (LRIS), was selected to manage the A/P Study data management program. CGIA operates the state's geographic information system (GIS).

The GIS was identified as the tool for accomplishing data management. A GIS is a hardware and software system used for compilation, storage, analysis, and display of geographic data referenced by x,y-coordinate pairs. With the GIS as an integrating tool, one of the goals of the A/P Study data management program is to minimize duplication of hardware, software, and data while providing for effective interfaces between other computer systems. In practice, this goal means that the A/P Study data management program will not attempt to duplicate the storage of large databases which already have established procedures for data acquisition and maintenance. Rather, A/P Study data management funds will be used to develop software interfaces to the databases so that data can be obtained in an effective manner when necessary. A final goal of the A/P Study data management program is to provide both local and remote access to users of the A/P Study Database once it is implemented. Users will

FIGURE 1

ALBEMARLE - PAMLICO ESTUARINE STUDY AREA



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January, 1990

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N.C. Dept. of Environment, Health, & Natural Resources

include resource managers at the federal, state, and local levels; researchers working in the A/P Study area; and private citizens or other organizations who have an interest in the area or produce data relevant to it.

1.2 A/P Study Data Needs Assessment

A data needs assessment was conducted for the A/P Study to identify the data needs of resource managers and researchers. The process used a structured methodology to document those needs in the form of data and software requirements, to supply recommendations for implementing the database, and to provide time and cost estimates. The structured methodology used for the A/P Study data needs assessment began with identification of a contact list. Over 75 senior managers, resource managers, researchers, and other technical staff were identified as having a contribution to make to the design of the A/P Study Database. In parallel with this effort, a questionnaire was developed to facilitate the capture of the necessary information for performing database design.

Once the contact list and the questionnaire were finalized, a series of 52 interviews were conducted with over 100 potential A/P Study Database users or user groups. Data needs were gathered based on four broad functional categories of data use: resource critical areas, water quality, fisheries dynamics, and the human environment. Completed questionnaires, interview notes, and data documentation provided by the interviewees were used to derive data priorities and requirements for the A/P Study Database and the necessary interface software. The data requirements are presented in Section 3 of this document. The A/P Study data needs assessment culminates with a set of implementation recommendations, costs, and a schedule. These will be included in a separate data implementation plan.

1.3 Purpose and Content of the Data Requirements Document

The purpose of the Data Requirements Document is to identify the data to be included in the A/P Study Database based on needs expressed by the user community. Data requirements consist not only of the list of cartographic data and attribute data but also descriptive information about the data such as data source, availability, currency, and digitization status. This descriptive information leads to complete definition of the data and provides an early indication of the size and cost of implementing the A/P Database.

The remainder of this document is divided into three sections, each describing a different aspect of the requirements for the A/P Study Database.

- Section 2 describes the three primary user groups that will access the A/P Study Database. These groups are: resource managers, the research community, and other potential users including private citizens. This section discusses the mission of each user group and the types of data relevant to accomplishment of that mission.

• Section 3 outlines the requirements for the A/P Study Database including cartographic data, attribute data, and bibliographic data. Requirements for a data inventory are also provided. Cartographic data requirements consist of the following information for each data layer: description, data condition, geographic coverage, data source and currency, expected frequency of use, use restrictions, data items associated with the layer, and any special considerations for managing the data. Attribute data requirements include the following information about each set of data : description and linkage to the cartographic data, data source and currency, and data items. Bibliographic data requirements include the types of materials to be stored and maintained in the A/P Study Database and the appropriate bibliographic citation for each type. Books, published reports, unpublished reports, published proceedings, and journal articles are the types of materials to be included. Requirements for the data inventory consist of the information to be gathered and maintained for each database or data file relevant to the A/P Study.

1.4 Overview of A/P Study Data and System Documentation

The A/P Study data management program will produce various documents to progressively define the database and software necessary to support the needs of resource managers and researchers involved in the A/P Study. The Data Requirements Document is the first in a series of design documents produced for the A/P Study. The set of documents are:

- Data Requirements Document
- Functional Description
- System/Subsystem Specification
- Database Specification
- Users Manual

The Data Requirements Document defines the data needs expressed by potential users of the system. The Functional Description provides a conceptual view of the software functionality of the A/P Data Management and Analysis System (A/P System). These two documents serve as the foundation upon which the System/Subsystem Specification and the Database Specification, respectively, are developed. The System/Subsystem Specification defines the software structure in more detail by expanding the Functional Description into a structured design. The Database Specification serves a similar purpose for the Data Requirements Document in that logical data definitions are transformed into a detailed, physical design of the A/P Study Database. A data dictionary is designed in conjunction with the Database Specification. It includes detailed information for all cartographic data and attribute data. All data items for every data layer are defined. The data dictionary is an appendix to the Database Specification. The Users Manual is then developed to guide the user toward taking full advantage of the software tools and data included in the design of the total A/P System.

SECTION 2

DESCRIPTION OF DATA USER GROUPS

A list of potential users of the A/P Study Database was compiled prior to conducting the data needs assessment. Two primary user groups were identified: resource managers and the research community. Resource managers represent various state and federal government agencies with management responsibilities within the A/P Study area. The research community represents university and laboratory researchers with a research interest in issues related to the A/P Study. Participants in the data needs assessment included both data developers and potential A/P Study Database users.

Resource managers and researchers that participated in the data needs assessment are described in the following two sections. Agencies that are represented on the A/P Study Policy Committee and/or the Technical Committee or have been awarded a technical project are indicated.

Another user group was identified during the data needs assessment. This user group includes private citizens, environmental groups, and industry representatives who could benefit from using the data contained in the A/P Study Database upon its implementation.

2.1 Resource Managers

Resource managers at the state and federal levels have the responsibility for protecting the natural resources of the State of North Carolina through effective management practices. These responsibilities include assessing resource use and trends, monitoring compliance with existing laws and regulations, and developing new laws and regulations to further protect the environment. The data needed to accomplish these missions are statewide in scope and involve large volumes of geographically-referenced data. Resource managers require data that are simultaneously general and specific. Overall trends data may come from statewide data accumulated over several months and years while data for environmental "hot spots" require detailed data for a small geographic area. Both ends of the spectrum are important in effective resource management. Specific instances may have implications for the broader, statewide view and give the resource manager a tool for beginning to derive management strategies. Detailed characteristics of each resource management organization are given in the following paragraphs.

2.1.1 State Government Agencies

2.1.1.1 Department of Environment, Health, and Natural Resources (Policy Committee and Technical Committee)

The North Carolina Department of Environment, Health, and Natural Resources (DEHNR) is the lead state agency for the Albemarle-Pamlico Estuarine Study and administers the state cost share funds for the study.

2.1.1.1.1 Division of Coastal Management (Technical Committee, Third Year Technical Project)

The Division is responsible for implementing a plan for the protection, preservation, orderly development, and management of the coastal area of North Carolina. The Division provides staff support to the Coastal Resources Commission, which administers the Coastal Area Management Act (CAMA). The Division processes major development permits; prepares guidelines for a local land use planning program in the CAMA counties; administers grants to local government for planning, permitting, and beach access programs; and acquires and manages coastal and estuarine reserves as natural areas for research, education, and preservation.

2.1.1.1.2 Division of Environmental Health

This Division is concerned with activities relevant to environmental health issues. Staff from the Environmental Health Services Section (Shellfish Sanitation Branch) and the Public Water Supply Section were interviewed.

The Shellfish Sanitation Branch is responsible for protecting the public health of the consumers of oysters, clams, scallops, and crustacean meat. The program conducts sanitary surveys of shellfish growing waters to determine which areas are safe for consumption of shellfish and inspects shellfish, scallop, and crustacean plants to certify compliance with sanitary requirements.

The Public Water Supply Section is the lead state office in implementing and enforcing state laws and Commission of Health Services rules pertaining to the surveillance, operation, and maintenance of public water supplies. The Public Water Supply Section is also responsible for implementing the federal Safe Drinking Water Act.

2.1.1.1.3 Division of Environmental Management (Technical Committee)

The Division is responsible for comprehensive planning and management of the state's air, surface water, and groundwater resources. The Division issues permits to control sources of pollution; monitors compliance at permitted facilities; evaluates ambient environmental quality; and pursues enforcement actions for violations of environmental regulations.

Interviews were conducted with representatives of the Air Quality Section, Water Quality Section, and Groundwater Section.

2.1.1.1.4 Division of Forest Resources (Technical Committee)

The Division has an active role in planning and administering all activities related to maintaining, protecting, and improving the forest resources of the state. Specific activities include management assistance to private landowners, reforestation services, forest fire prevention and suppression, and insect and disease control programs.

2.1.1.1.5 Division of Land Resources

The purpose of the Division is to protect and conserve the state's land, minerals, and related resources through the effective implementation and management of programs related to sedimentation pollution control, mined land reclamation, dam safety, land records management, geodetic survey, resources inventory and analysis, and mineral resources conservation and development.

2.1.1.1.6 Division of Marine Fisheries (Technical Committee, First and Second Year Technical Projects)

The Division is responsible for the maintenance, preservation, protection, and development of all marine and estuarine fisheries resources. This includes the promulgation and enforcement of rules governing coastal fisheries; scientific endeavors leading to the development of information on which regulatory and developmental decisions will be based; and developmental activities intended to improve the cultivation, harvesting, and marketing of shell and finfish.

2.1.1.1.7 Division of Parks and Recreation (Second and Third Year Technical Projects)

The Division administers the state park system which includes state parks, state natural areas, state recreation areas, state trails, state lakes, and natural and scenic rivers. The park system functions to preserve unique examples of archaeological, biologic, geologic, scenic, and recreational resources.

2.1.1.1.8 Division of Soil and Water Conservation (Technical Committee, First, Second, and Third Year Technical Projects)

The Division administers a comprehensive, statewide program for conserving the state's soil and water resources.

2.1.1.1.9 Division of Solid Waste Management

The Division is responsible for programs to identify solid and hazardous waste sites in the state. One of the programs, the Superfund Program, is responsible for identifying and cleaning up uncontrolled hazardous waste sites. This program is conducted in cooperation with the Environmental Protection Agency. The Superfund Program also evaluates uncontrolled hazardous waste sites that do not fall under the jurisdiction of the federal government.

2.1.1.1.10 Division of Water Resources

The Division manages programs for planning, technical assistance, and financial assistance for river basin management, water supply, water conservation, navigation, stream clearance, flood control, beach protection, aquatic weed control, hydroelectric power, and recreational uses of water.

2.1.1.1.11 Wildlife Resources Commission (Technical Committee)

The Wildlife Resources Commission administers programs in waterfowl management, non-game and endangered species management, inland fisheries, and wetlands wildlife management management.

2.1.1.2 Other State Government Agencies

2.1.1.2.1 Office of the Governor, Office of State Budget, State Data Center

In its capacity as a depository for data products from the Bureau of the Census and the Bureau of Economic Analysis, and as an administratively mandated registrar for state government data series, the State Data Center is the point of entry for a variety of statistical information available from state and federal agencies. The State Data Center disseminates decennial, economic, and agricultural census information, acts as a data clearinghouse, and publishes statistical compendia for the state and its counties.

2.1.1.2.2 Department of Cultural Resources, Division of Archives and History, Archaeology and Historic Preservation Section

The Archaeology and Historic Preservation Section conducts a statewide program to identify, examine, and protect and /or preserve the state's historical and archaeological resources.

2.1.1.2.3 Department of Transportation

The Department of Transportation is responsible for the design, construction, and maintenance of state highways and roads. Responsibilities include the review of Section 401 and Section 404 permits and the development and implementation of wetlands destruction mitigation plans.

2.1.1.2.4 Department of Agriculture (Technical Committee)

The Department of Agriculture's Division of Statistics is responsible for the generation, storage, and dissemination of agricultural output for the State of North Carolina.

2.1.1.2.5 Department of Economic and Community Development, Division of Community Assistance

The Division provides aid to North Carolina's counties and municipalities in the areas of community development, land use, public management, and economic development.

2.1.2 Federal Government Agencies

2.1.2.1 Environmental Protection Agency (Policy Committee and Technical Committee)

The Environmental Protection Agency is the lead federal agency for the A/P Study and administers the federal cost share funds for the study.

2.1.2.2 U.S. Army Corps of Engineers (Technical Committee)

The Corps of Engineers is responsible for planning, design, construction, operation and maintenance of projects for flood control, water supply for municipalities and industry, recreation and fish and wildlife management, and environmental management. The Corps also serves a regulatory function, reviewing permit applications for proposed activities in waters of the United States. In this role, the Corps ensures a balance between the public interest in environmental protection for proposed fills and commercial development.

2.1.2.3 Southeast Fisheries Center, National Marine Fisheries Service (Technical Committee, First, Second, and Third Year Technical Projects)

The Southeast Fisheries Center provides scientific and technical information for decision making in conserving, developing, and utilizing marine fishery resources and in conserving and protecting the habitat, mammals, and endangered species of the marine environment. The mission of the Southeast Fisheries Center is to understand the biological productivity of estuaries and nearshore ecosystems, the dynamics of coastal fishery resources, and the effects of man on resource productivity in order to enhance recreational and commercial fishery resources along the southeastern coast of the United States.

2.1.2.4 U.S. Fish and Wildlife Service (Policy Committee, First Year Technical Project)

The mission of the U.S. Fish and Wildlife Service is to provide the federal leadership to conserve, protect, and enhance fish and wildlife and their habitat for the continuing benefit of the people. The Service facilitates the balanced development of the nation's natural resources by timely and effective provisions of fish and wildlife information and recommendations to assure the natural diversity and continuing survival of fish and wildlife. Within the A/P Study project area, the Service manages nine National Wildlife Refuges.

2.1.2.5 U.S. Geological Survey, Water Resources Division (Technical Committee, First, Second, and Third Year Technical Projects)

U.S. Geological Survey collects, disseminates, and evaluates information on water availability, quantity, and quality to help guide the development, management, and use of the nation's water resources.

2.2 Research Community

2.2.1 University Programs

Several laboratories and research facilities play a significant role in examining issues related to the estuarine environment. These facilities are affiliated with various North Carolina universities and include:

- Duke University Marine Laboratory (Policy Committee)
- UNC Institute for Marine Sciences (Policy Committee)
- University of North Carolina Sea Grant College Program (Technical Committee, Second Year Technical Project)
- Water Resources Research Institute (Technical Committee)

Representatives from each of the facilities were interviewed during the data needs assessment.

2.2.2 Researchers with A/P Study Technical Projects

Dr. David Adams, North Carolina State University, "Environmental Management Plan for Currituck Sound" (Third Year)

Dr. Mark Brinson, East Carolina University, "Ecological Functions and Value of Fringe Swamps" (First Year)

Dr. Graham Davis, East Carolina University, "Distribution and Management Potential for Submerged Aquatic Vegetation" (First Year)

Dr. Thomas Hoban, North Carolina State University, "Public Attitudes/Water Quality and Management Alternatives" (Third Year)

Dr. Edward Kuenzler, University of North Carolina, "Nutrient Reduction By Coastal Swamps" (First, Second, and Third Years)

Dr. Edward Noga, North Carolina State University, "Shell Disease in Blue Crabs Callinectes Sapidus" (Second and Third Years)

Dr. Sonia Ortega, Duke University Marine Laboratory, "Environmental Determination of Oyster Success in the Pamlico Sound" (First Year)

Dr. Hans Paerl, UNC Institute for Marine Sciences, "Potential for Eutrophication and Nuisance Algal Blooms" (First, Second, and Third Years)

Dr. Ray Palmquist, North Carolina State University, "Value of Recreational Fishing on the Albemarle and Pamlico Estuaries" (First Year)

Dr. Leonard Pietrafesa, North Carolina State University, "Albemarle-Pamlico Sound Coupling Study" (Second Year)

Dr. Stanley Riggs, East Carolina University, "Heavy Metal and Organic-Rich Mud Pollutants" (First, Second, and Third Years)

Dr. Roger Rulifson, East Carolina University, "Abundance and Viability of Striped Bass Eggs Spawned in the Roanoke River 1989", "Food and Feeding of Larval Fishes in the Lower Roanoke River and Western Albemarle Sound" "Water Quality as a Function of Discharge from the Roanoke Rapids Reservoir During Hydropower Generation" (Second Year)

Dr. Wayne Skaggs, North Carolina State University, "Effects of Water Management and Land Use Practices on Hydrology and Water Quality" (Second Year)

Dr. Kerry Smith, North Carolina State University, "Value of Recreational Fishing on the Albemarle and Pamlico Estuaries" (First Year)

Dr. John Sutherland, Duke University Marine Laboratory, "Environmental Determination of Oyster Success in the Pamlico Sound" (First Year)

Dr. Paul Tschetter, East Carolina University, "Characterization of Baseline Demographic Trends in Permanent and Temporary Populations" (First Year)

Dr. John Wells, UNC Institute for Marine Sciences, "Scoping Study of Distribution, Composition, and Dynamics of Water Column and Bottom Sediments" (First Year)

2.2.3 Other Researchers

Dr. Wendell Gilliam, North Carolina State University
Dr. Siamak Khorram, North Carolina State University
Dr. Curt Richardson, Duke University

2.3 Other Potential Users

There are a variety of potential users of the A/P Study Database who do not fall into the resource management or research community categories outlined above. The users in this group include private citizens, environmental groups, and private industry representatives who have an interest in the region based upon personal reasons, lobbying activities on behalf of environmental issues, or business activities. The A/P Study Database will be made available for use by these groups as well.

SECTION 3

DATA REQUIREMENTS

The A/P Study Database will eventually consist of: (1) data layers that include cartographic and attribute data and (2) bibliographic data that represent citations of literature and other data relevant to the A/P Study area. This breakdown of data is illustrated in Figure 2. The requirements for cartographic data, attribute data, and bibliographic data to support A/P System users are outlined in this section.

Specifications for each data layer were derived through a needs assessment of potential users of the A/P Study Database. Many of the same data layers were mentioned as important by the majority of users. A master list of data layers was determined and an implementation priority was derived for each layer based on two factors: perceived utility and ease of data acquisition. Perceived utility was defined as a measure of the usefulness of a data layer expressed by potential users of the data. Ease of data acquisition was defined as a qualitative and, where possible, quantitative assessment of the effort required to obtain complete geographic coverage of the data layer in a digital form given the current condition of the best available data. Each data layer was scored on a five-point scale ("five" being the highest) for each factor. Scores for the two factors for a data layer were multiplied yielding an overall score. Cartographic data implementation priorities were ranked by the overall score. The resulting list of priorities is shown in Table 1. Nine data layers were identified as prerequisites for building the A/P Database due to their critical content. These layers were removed from the scoring process and are the first layers listed in Table 1. Section 3.1 is organized based on the order shown in Table 1.

Some of the data layers exist in digital form at CGIA and are available for use. Many others do no exist at CGIA and must be acquired through data management funds. Formal interagency agreements need to be established prior to implementation of the A/P Study Database for two reasons: (1) to ensure that the A/P Study data management program is able to obtain the latest updates to data layers already residing on the GIS and (2) to ensure that completely new data layers can be obtained in a timely manner. Once the agreements are established, the A/P Study data management program will be responsible for making the technical arrangements to obtain the data.

3.1 Cartographic Data

Cartographic data will be the heart of the A/P Study Database. Resource management decisions for the study area require thorough examination of large volumes of environmental data, summarized and portrayed most effectively in a graphic form, to arrive at the best solutions for spatial analysis. This section describes

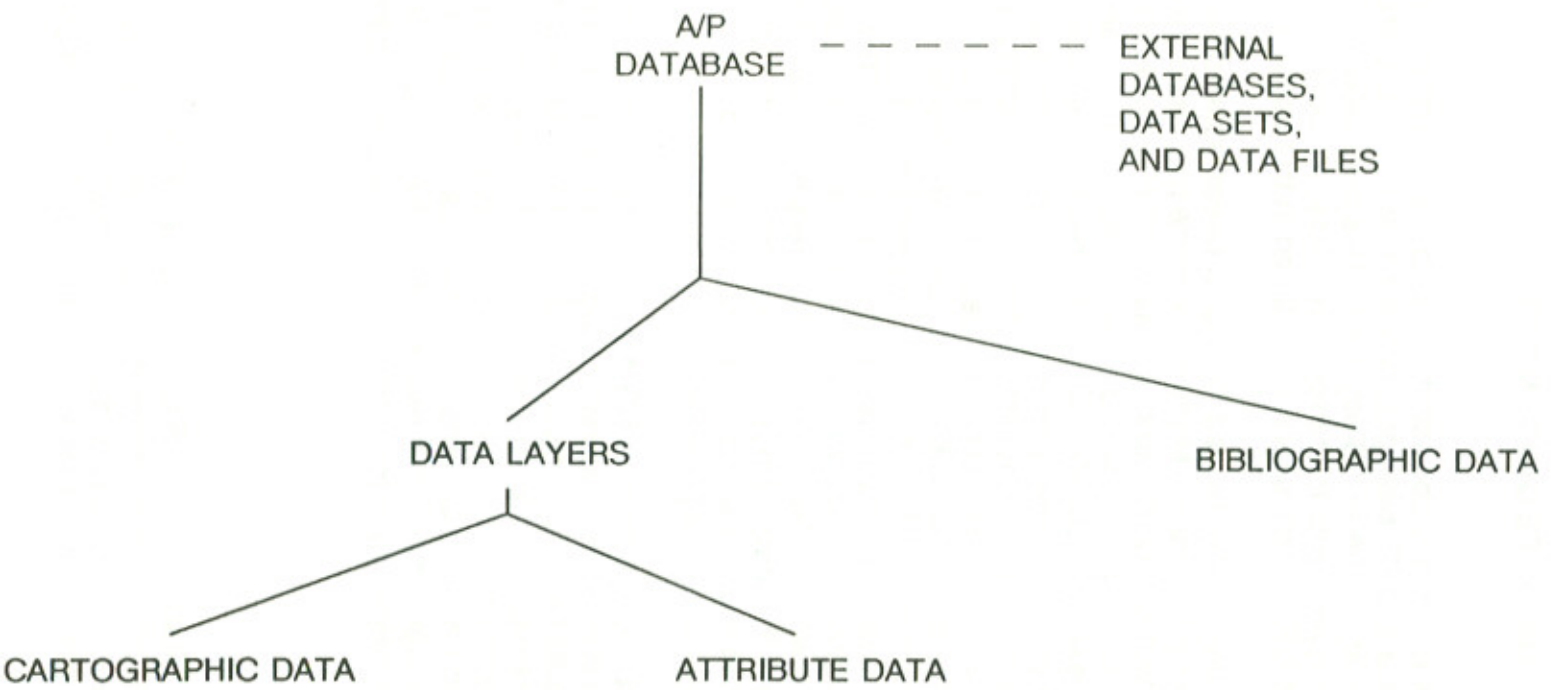

FIGURE 2 Hierarchy of Data Terms

PARAGRAPH NO.	NAME
3.1.1	State Boundary
3.1.2	A/P Study Area Boundary
3.1.3	County Boundaries
3.1.4	Subbasins
3.1.5	Quad-County-Subbasin Boundaries
3.1.6	Hydrography
3.1.7	Land Use and Land Cover
3.1.8	Point Source Dischargers
3.1.9	Wetlands and Deep Water Habitats
3.1.10	Ambient Water Quality Monitoring Sites
3.1.11	Natural Heritage Inventory
3.1.12	1980 Census Boundaries
3.1.13	Surface Water Intakes
3.1.14	Submerged Aquatic Vegetation
3.1.15	Superfund Sites
3.1.16	1990 Census Boundaries
3.1.17	Coastal Reserves
3.1.18	Fisheries Biological Monitoring Sites
3.1.19	Oyster Cultch Plant Sites
3.1.20	Game Lands
3.1.21	Heavy Metal and Organic-Rich Mud Pollutants Sample Sites
3.1.22	Citizen Water Quality Monitoring Sites
3.1.23	Mussel Distribution
3.1.24	Bottom Sediment Sample Locations
3.1.25	Federal Land Ownership
3.1.26	Nursery Areas
3.1.27	Shellfish Evaluation Areas
3.1.28	Oyster Producing Areas
3.1.29	Outstanding Resource Waters
3.1.30	1970 Census Boundaries
3.1.31	Artificial Reefs
3.1.32	CAMA Major Development Permits
3.1.33	General Soils
3.1.34	Transportation
3.1.35	State Park Boundaries
3.1.36	Stream-Gaging Stations
3.1.37	Marinas

TABLE 1 List of Cartographic Data

PARAGRAPH NO.	NAME
3.1.38	Peat Lands
3.1.39	Anadromous Fish Areas
3.1.40	Public Water Supplies (Groundwater Intakes)
3.1.41	Solid Waste Facilities
3.1.42	Aquifers
3.1.43	Detailed Soils
3.1.44	Municipal Boundaries
3.1.45	Pollution Incidents
3.1.46	Ambient Air Monitoring Sites
3.1.47	Air Quality Permits
3.1.48	Air Emissions Inventory
3.1.49	Water Quality Sample Project Locations
3.1.50	Mining Permits
3.1.51	Lease Blocks
3.1.52	Geology
3.1.53	Geodetic Control Points
3.1.54	Sea Turtle Population
3.1.55	Ocean Fishing Pier Licenses
3.1.56	Military Air Space
3.1.57	Fishing Water Jurisdictions
3.1.58	Historic and Archaeological Sites, Buildings, and Structures
3.1.59	Water Quality Monitoring Sites (Groundwater)
3.1.60	Water Level Monitoring Sites (Groundwater)
3.1.61	Dam Inventory
3.1.62	Elevation
3.1.63	Watersheds
3.1.64	Bathymetry

TABLE 1 List of Cartographic Data (Continued)

the cartographic data necessary to support A/P Study Database users. The cartographic data for a data layer are documented by the following information:

Description	states the data type (point, line, polygon), general definition of data content, and information about mapping performed prior to digitization where relevant and available
Data Condition	indicates status of the data such as digital or non-digital and if the data resides at CGIA; indicates status of Virginia portion of A/P Study area
Geographic Coverage	describes the digital, spatial extent of the data such as statewide, coastal, or Albemarle/Pamlico estuarine areas
Source and Currency	indicates the data source agency and how recent the data are
Expected Frequency of Use	states an estimate of the utility of the data based on comments from potential users; possible responses are:

widespread	most users; constant use
frequent	high level of use but less than widespread
average	moderate use by some users
infrequent	occasional use by a few users

Use Restrictions	indicates any limitations on distribution and use of the data imposed by the source agency
Update Frequency	indicates how often the source agency will be asked to provide updates to the data
Items	lists the data items that are considered important to associate with the cartographic data
Special Considerations	describes any technical data management issues such as integration of data with other layers

3.1.1 State Boundary

Description

- Polygon data defining the political boundary of North Carolina

Data Condition

- Digital, resident at CGIA

Geographic Coverage: Statewide for North Carolina and A/P Study portion of Virginia

Source and Currency

- North Carolina Department of Transportation (DOT) county maps at a scale of 1:126,720 are current data source; United States Geological Survey (USGS) 1:100,000-scale Digital Line Graph (DLG) data are future data source
- Data represent current state boundaries

Expected Frequency of Use: widespread

Use Restrictions: none

Update Frequency: none

Items: none

Special Considerations: none

3.1.2 A/P Study Area Boundary

Description

- Polygon data defining the extent of the A/P Study area in North Carolina and Virginia
- Mapped at a scale of 1:1,000,000

Data Condition

- Digital, resident at CGIA

Geographic Coverage: A/P Study area

Source and Currency

- A/P Study Office is data source
- Boundary data represent the current A/P Study boundary

Expected Frequency of Use: frequent

Use Restrictions: none

Update Frequency: as needed

Items: none

Special Considerations: due to small scale original mapping used, boundary may not integrate well with subbasin boundaries

3.1.3 County Boundaries

Description

- Polygon data defining the political boundary of each county

Data Condition

- Digital, resident at CGIA
- Boundaries digitized as part of USGS 1:100,000-scale and 1:24,000-scale DLG program

Geographic Coverage: Statewide for North Carolina and A/P Study portion of Virginia

Source and Currency

- North Carolina Department of Transportation (DOT) county maps at a scale of 1:126,720 and USGS 1:100,000-scale DLG data are current data sources
- Data represent current county boundaries

Expected Frequency of Use: widespread

Use Restrictions: none

Update Frequency: none

Items: county name, FIPS code

The following attribute data are linked to the County Boundaries data:

- Agricultural Output Statistics
- Big Game Kill Reports Data
- Boat Registrations Data
- Building Permits Data
- Census of Agriculture
- Census of Manufactures/Mineral Industries
- Census of Wholesale and Retail Trade
- County Business Patterns Data
- Fish Processing Operations Data
- Furbearer Harvest Data
- Hazardous Waste Facilities Data
- Mechanical Harvest of Clams Permits Data
- Operating Unit Survey Data
- Outdoor Recreation Facility Inventory Data
- Oyster, Scallop, and Clam Licenses Data
- Population Estimates/Projections Data
- Pound Net Registrations Data
- Recreational Fishery Statistics
- Seafood Dealer Licenses Data
- Tourism Expenditures and Employment Data
- Vessel Licenses/Permits Data
- Water Quality Data Analysis

Special Considerations: boundaries need to be integrated with 1:100,000-scale digital shoreline; possibility of using Log In to North Carolina (LINC) database to tie into demographic data associated with counties

3.1.4 Subbasins

Description

- Polygon data delineating all components of each river basin
- Mapped at a scale of 1:1,000,000

Data Condition

- Digital, resident at CGIA
- Need comparable cartographic data for Virginia

Geographic Coverage: Statewide for North Carolina

Source and Currency

- "Major River Basins as Designated by the Department of Natural and Economic Resources" published by the DEHNR-DEM is data source
- Data are current through 1982

Expected Frequency of Use: widespread

Use Restrictions: none

Update Frequency: none

Items: identification number, river basin name

Special Considerations: potential need to integrate this data with cartographic data from other data layers and refine the boundaries

3.1.5 Quad-County-Subbasin Boundaries

Description

- Polygon data derived by from overlay of 7.5-minute quad, county, and subbasin boundaries

Data Condition

- Future cartographic data
- Source data are needed for Virginia portion of data

Geographic Coverage: None

Source and Currency

- USGS is data source for quad and county information; DEHNR-DEM is data source for subbasins
- Most current data available will be used to develop this cartographic data

Expected Frequency of Use: widespread

Use Restrictions: none

Update Frequency: none

Items: none

Special Considerations: none

3.1.6 Hydrography

Description

- Polygon, line, and point data consisting of streams and rivers, lakes and ponds, wetlands, reservoirs, and shorelines (and expanded to include DEHNR-DMF water body classification)
- Layer exists at scales of 1:24,000 and 1:100,000

Data Condition

- CGIA has complete, digital USGS 1:100,000-scale DLG data (21 maps) for North Carolina
- CGIA has DLG data for 121 of 365 total maps at the 1:24,000-scale for North Carolina with another 63 maps being digitized by a private contractor through the USGS
- CGIA has complete, digital USGS 1:100,000-scale DLG data (seven maps) for Virginia
- None of the 86 maps covering the Virginia portion of the A/P Study area at 1:24,000-scale are in digital form

Geographic Coverage: Statewide at 1:100,000-scale for North Carolina, partial for Virginia; partial at 1:24,000-scale for North Carolina, none for Virginia

Source and Currency

- USGS has a long-standing commitment to produce DLG data for the entire country at scales of 1:24,000 and 1:100,000 (hydrography is one data layer of the DLG effort)
- Currency varies among the set of 1:100,000-scale and 1:24,000-scale quads

Expected Frequency of Use:

- Widespread
- Frequent use in studies, such as water quality investigations, where users may tie the cartographic data (i.e., stream segments) to external databases containing water quality parameter information

Use Restrictions: none

Update Frequency: none

Items: subbasin name or identifier, county, quad name, DEHNR-DEM stream classification codes, stream type, stream name or identifier, EPA reach number, stream order, DEHNR-DMF water body code, water quality classification

The following attribute data are linked to the Hydrography data:

- Ambient Water Quality Monitoring Data
- Boating Access Areas Data
- Commercial Landings Data
- Fisheries Biological Monitoring Data
- Pound Net Registrations Data
- Recreational Fishery Statistics
- Striped Bass Reproduction Monitoring Data

Special Considerations: external edgematching between adjacent map sheets has not been completed for the 1:24,000-scale nor the 1:100,000-scale files; hydrographic features are a common hook into databases external to the A/P Study Database, particularly in the area of water quality; the 1:100,000-scale files will be the base for the Hydrography data

3.1.7 Land Use and Land Cover

Description

- Polygon data identifying human uses of the land (e.g., housing and industry) and the vegetation, water, natural surface, and construction on the land surface
- Minimum resolution required by users is the USGS Level II land use/land cover classification (Anderson et al., 1976); see Appendix B for further definition of USGS Level II classification scheme

Data Condition

- Partially digital, resident at CGIA
- New digital data for entire A/P Study area under development at CGIA using remote sensing techniques
- USGS Land Use Data Analysis (LUDA) data are resident at CGIA for the entire A/P Study area

Geographic Coverage: Dare, Carteret, Hyde, Tyrrell, and Washington counties in North Carolina; no current coverage for Virginia

Source and Currency

- East Carolina University, Department of Geography is data source for existing data
- Existing data are current through 1982
- Earth Observation Satellite (EOSAT) Company is data source for Landsat Thematic Mapper imagery to cover complete A/P Study area
- Landsat Thematic Mapper images are from 1987 and 1988
- USGS LUDA maps are data source for LUDA data

Expected Frequency of Use: widespread, particularly if provided at Level II or better

Use Restrictions: none

Update Frequency: every five years

Items: land use type, county, quad name, subbasin

Special Considerations: new digital coverage under development at CGIA will be registered to the 1:100,000-scale shoreline

3.1.8 Point Source Dischargers

Description

- Point data of locations of permits issued for sewer systems, treatment works, or disposal systems that result in a discharge into surface waters

Data Condition

- Digital, resident at CGIA
- Latitude/longitude coordinates obtained from an attribute data set are currently being verified
- Need comparable cartographic data for Virginia

Geographic Coverage: Statewide for North Carolina

Source and Currency

- DEHNR-DEM is data source
- Data represent current locations; new sites are added periodically

Expected Frequency of Use: frequent

Use Restrictions: none

Update Frequency: quarterly

Items: DEHNR-DEM identification number, North Carolina permit number, active discharger designation, county, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: procedures for updating need to be defined as well as frequency of updates

3.1.9 Wetlands and Deep Water Habitats

Description

- Polygon and line data identifying lands where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in and on the soil, and permanently flooded lands
- Mapping effort under way at the U.S. Fish and Wildlife Service (USFWS) to produce National Wetlands Inventory (NWI) for the entire country at a scale of 1:24,000

Data Condition

- Non-digital
- NWI maps need to be digitized for A/P Study area when available

Geographic Coverage: None in digital form

Source and Currency

- USFWS NWI is data source
- Other wetlands mapping efforts conducted in the past for specific wetlands in smaller areas than the A/P Study area could be used as secondary sources for development of digital wetlands data

Expected Frequency of Use: widespread, many users specifically mentioned the need to convert USFWS mapping to digital form

Use Restrictions: none

Update Frequency: as needed

Items: wetland type, county, quad name, subbasin

Special Considerations: none

3.1.10 Ambient Water Quality Monitoring Sites

Description

- Point data representing locations where water quality data are collected on a routine basis and analyzed for presence of various chemicals

- Sites are the link between A/P Study Database and massive volume of water quality parameter data available in EPA STOrage and RETrieval (STORET) water quality database

Data Condition

- Digital, resident at CGIA
- Virginia ambient water quality monitoring sites need to be obtained

Geographic Coverage: Statewide for North Carolina

Source and Currency

- DEHNR-DEM (Water Quality Section) is data source
- Site locations are constant, associated water quality parameter data change daily

Expected Frequency of Use: widespread

Use Restrictions: none

Update Frequency: quarterly

Items: identification number, county, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: determination of best means to link A/P Study Database to STORET through the site location identification is needed; accessing the Virginia sites and date should be similar to accessing to North Carolina sites

3.1.11 Natural Heritage Inventory

Description

- Polygon and point data of locations of rare and endangered species populations and occurrences of exemplary or unique natural ecosystems (terrestrial and palustrine) and special wildlife habitats
- Mapped at a scale of 1:24,000

Data Condition

- Point locations of rare and endangered species are digital, obtainable by CGIA
- Mapped areas need to be digitized
- Virginia Natural Heritage Inventory locations need to be obtained

Geographic Coverage: None in digital form

Source and Currency

- DEHNR-DPR is data source; natural areas being mapped through an A/P Study-funded research project
- Data are current through 1989

Expected Frequency of Use: widespread

Use Restrictions: due to the locational information provided on endangered or threatened species, limitations on access need to be defined

Update Frequency: semi-annually

Items: identification of element, county, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: none

3.1.12 1980 Census Boundaries

Description

- Polygon data of boundaries used to collect and tabulate socioeconomic data for the 1980 Decennial Census
- Original data maintained at scale of 1:126,720

Data Condition

- Digital, resident at CGIA
- Virginia 1980 census boundaries need to be obtained

Geographic Coverage: Statewide for North Carolina

Source and Currency

- Bureau of the Census is data source
- Data are post-1980 Census information

Expected Frequency of Use: widespread for trend analyses when 1990 Census data are available

Use Restrictions: none

Update Frequency: none

Items: identification number, county, quad name, subbasin, census geography (other related items appear in various attribute data sets)

Special Considerations: problems exist with consistency of current data at CGIA; some counties include census tracts while others have enumeration districts; no one-to-one correspondence from CGIA holdings to census tapes; data are linked to County Boundaries (see paragraph 3.1.3)

3.1.13 Surface Water Intakes

Description

- Point data identifying locations where communities draw raw water from a lake, river, or stream; treat it; and distribute treated water to residences and businesses

Data Condition

- Digital, resident at CGIA
- Latitude/longitude coordinates obtained from an external data set are currently being verified
- Need comparable cartographic data for Virginia

Geographic Coverage: Statewide for North Carolina

Source and Currency

- DEHNR-DEM (Water Quality Section) is data source
- Data represent current locations

Expected Frequency of Use: frequent

Use Restrictions: none

Update Frequency: annually

Items: DEHNR-DEM identification number, county, quad name, subbasin,watershed classification (other related items appear in an attribute data set)

Special Considerations: none

3.1.14 Submerged Aquatic Vegetation

Description

- Polygon data defining location and areal extent of seagrass and other aquatic vegetation species
- Mapped using aerial photography at scales of 1:20,000, 1:24,000, and 1:50,000

Data Condition

- Partially digital, resident at CGIA
- Core and Bogue Sounds have been mapped and digitized in cooperation with DEHNR-DMF
- Additional aerial photography needs to be interpreted and charted to complete this data

Geographic Coverage: Core and Bogue Sounds only in North Carolina (additional aerial photography includes Albemarle, Back, Croatan, Currituck, and Pamlico Sounds)

Source and Currency

- NOAA/National Marine Fisheries Service (NOAA/NMFS) is data source
- Data currency includes various geographic coverage for 1981, 1985, 1986, and 1988

Expected Frequency of Use: average

Use Restrictions: developers of this data are concerned with assuring the correct use of the data; before the data are used to draw scientific conclusions potential users are requested to contact the NOAA/NMFS for background on how the areas were defined

Update Frequency: as needed

Items: identification number, species of seagrass present, county, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: none

3.1.15 Superfund Sites

Description

- Point data of locations of uncontrolled, unregulated, and unevaluated hazardous waste sites
- Total of 21 national priority sites in North Carolina, expected to increase yearly

Data Condition

- Digital, in an external data set obtainable by CGIA
- Latitude/longitude coordinates are being developed to precisely locate the sites
- Virginia Superfund sites need to be obtained

Geographic Coverage: Statewide for North Carolina

Source and Currency

- DEHNR-DSWM is data source
- Data will be current when verification of latitude/longitude coordinates is complete

Expected Frequency of Use: average

Use Restrictions: assistance may be needed from DEHNR-DSWM to determine the degree of data sensitivity

Update Frequency: annually

Items: site number, city, county, congressional district, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: none

3.1.16 1990 Census Boundaries

Description

- Polygon data of statistical and political boundaries used to collect and tabulate socioeconomic data for the 1990 Decennial Census
- Distributed for the entire country in the form of Topologically Integrated Geographic Encoding and Referencing (TIGER) files

Data Condition

- Digital, resident at CGIA
- Postcensus versus will be available in mid-1991 with census tabulation codes
- Virginia 1990 census boundaries need to be obtained

Geographic Coverage: Statewide for North Carolina

Source and Currency

- Bureau of the Census is data source with most base map information obtained through cooperative effort with USGS using 1:100,000-scale DLG data
- Data are a combination of current Bureau of Census statistical and other boundaries, and DLG boundaries compiled at various dates

Expected Frequency of Use: widespread when attribute data become available in 1991

Use Restrictions: none

Update Frequency: once, when postcensus TIGER files are released

Items: identification number, county, quad name, subbasin, census geography (many other items exist as part of attribute data sets)

Special Considerations: none

3.1.17 Coastal Reserves

Description

- Polygon data identifying state-owned, research areas that are completely protected to provide scientists and students with the opportunity to examine the ecological relationships within the area over time (established under the provisions of the Coastal Zone Management Act)
- Mapped at a scale of 1:24,000

Data Condition

- Partially digital, resident at CGIA
- Three of four areas have been digitized
- Need comparable cartographic data for Virginia

Geographic Coverage: Coastal North Carolina

Source and Currency

- DEHNR-DCM is data source
- Data were mapped in 1986 with current source material

Expected Frequency of Use: infrequent

Use Restrictions: none

Update Frequency: as needed

Items: abbreviated sanctuary name, county, quad name, subbasin

Special Considerations: number of coastal reserves may expand in the future

3.1.18 Fisheries Biological Monitoring Sites

Description

- Point data of locations where fishery independent (e.g., estuarine trawl samples) and dependent (e.g., catches subsampled from long haul, winter trawl, pound net, etc.) data are collected on a seasonal/monthly basis for various programs
- Mapped at a scale of 1:24,000

Data Condition

- Digital, resident at CGIA
- Need comparable cartographic data for Virginia

Geographic Coverage: Albemarle/Pamlico estuarine areas

Source and Currency

- DEHNR-DMF is data source
- Data are current through 1984 with updates gradually being made by DMF

Expected Frequency of Use: frequent

Use Restrictions: developers of this data are concerned with assuring the correct use of the data; before the data are used to draw scientific conclusions potential users are requested to contact the DEHNR-DMF for background on data for the sites

Update Frequency: annually

Items: station identifier, program code, water body code, county, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: attribute data are stored at the State Information Processing Services (SIPS) facility in addition to CGIA

3.1.19 Oyster Cultch Plant Sites

Description

- Point and line data identifying locations where shell or similar material has been planted for oyster spat to attach themselves

Data Condition

- Digital, resident at CGIA
- Need comparable cartographic data for Virginia

Geographic Coverage: Albemarle/Pamlico estuarine areas

Source and Currency

- DEHNR-DMF is data source
- Data are current through 1984

Expected Frequency of Use: frequent

Use Restrictions: developers of this data are concerned with assuring the correct use of the data; before the data are used to draw scientific conclusions potential users are requested to contact the DEHNR-DMF for background on data for the sites

Update Frequency: as needed

Items: county, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: none

3.1.20 Game Lands

Description

- Polygon data identifying public areas where hunting, trapping, and fishing are permitted
- Mapped onto 1:126,720-scale DOT county maps

Data Condition

- Digital, resident at CGIA
- Need comparable cartographic data for Virginia

Geographic Coverage: Statewide for North Carolina

Source and Currency

- Wildlife Resources Commission (WRC) is data source
- Data currency is 1988-89

Expected Frequency of Use: average, but important for investigators of impacts upon the wildlife environment

Use Restrictions: restrictions may be applied for access if certain species become threatened or endangered

Update Frequency: as needed

Items: name, county, ownership, habitat type, quad name, subbasin

Special Considerations: none

3.1.21 Heavy Metal and Organic-Rich Mud Pollutants Sample Sites

Description

- Point data of research sample sites where physical measurements are taken and chemically analyzed to determine levels of concentration of various pollutants

Data Condition

- Partially digital, obtainable by CGIA
- Pamlico River data available, Neuse River data being developed, and Albemarle Sound data to be developed in 1990
- LORAN-C (range and bearing) coordinates have been recorded for each site and converted to latitude/longitude values

Geographic Coverage: Pamlico River and Neuse River in North Carolina

Source and Currency

- East Carolina University, Department of Geology (Principal Investigator: Dr. Stan Riggs) is data source through an A/P Study-funded research project

- Pamlico River data were collected in 1988, Neuse River are currently being collected, and Albemarle Sound data will be collected in 1990

Expected Frequency of Use: average

Use Restrictions: none

Update Frequency: as needed

Items: identification number, county, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: none

3.1.22 Citizen Water Quality Monitoring Sites

Description

- Point data of locations where private citizens are routinely taking water samples to assess water quality
- Mapping at a scale of 1:100,000

Data Condition

- Digital, resident at CGIA
- Mapped locations need to be digitized

Geographic Coverage: Tar River and Pamlico River in North Carolina

Source and Currency

- Pamlico-Tar River Foundation is data source
- Data are being collected weekly for the 50 sites

Expected Frequency of Use: infrequent

Use Restrictions: none

Update Frequency: as needed

Items: identification number, county, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: none

3.1.23 Mussel Distribution

Description

- Point data documenting existence of 13 different species of fresh water mussels that are a good water quality indicator because their life span can range up to 75 years
- Locational aspect of the data is based on individual streams at sampling interval of every one-tenth mile
- Mapped at a scale of 1:100,000

Data Condition

- Digital, resident at CGIA

Geographic Coverage: Tar-Pamlico River basin in North Carolina

Source and Currency

- WRC is data source
- Data are currently being collected through a USFWS-funded effort

Expected Frequency of Use: average

Use Restrictions: none

Update Frequency: as needed

Items: identification number, stream name, county, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: none

3.1.24 Bottom Sediment Sample Locations

Description

- Point data identifying sample locations for 25 different sample data sets
- Information gathered from analysis of data from previous research projects

Data Condition

- Digital, resident at CGIA
- Tabular x,y-coordinates were provided and verified

Geographic Coverage: Albemarle and Pamlico Sounds (Neuse, Pamlico, Roanoke, and Chowan River systems)

Source and Currency

- UNC Institute of Marine Sciences (Principal Investigator: Dr. John Wells) is data source through an A/P Study-funded research project
- Data represent locations identified through research in 1988-89

Expected Frequency of Use: average

Use Restrictions: none

Update Frequency: none

Items: identification number, county, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: none

3.1.25 Federal Land Ownership

Description

- Polygon data delineating federally-owned property
- Mapped at a scale of 1:250,000

Data Condition

- Digital, resident at CGIA
- Virginia federal land ownership data need to be obtained

Geographic Coverage: Statewide for North Carolina

Source and Currency

- USGS is data source for the maps for digitizing as well as the data
- Some updates have been made to this data since first entry in 1977 using DOT county maps for Alligator River National Wildlife Refuge

Expected Frequency of Use: frequent

Use Restrictions: none

Update Frequency: as needed

Items: name of property, ownership (federal department), county, quad name, subbasin

Special Considerations: none

3.1.26 Nursery Areas

Description

- Polygon data identifying primary and secondary locations where young marine animals grow
- Mapped at a scale of 1:24,000

Data Condition

- Digital, resident at CGIA
- Primary nursery area data undergo annual updates
- New mapping and digitization are complete for secondary nursery areas
- Need comparable cartographic data for Virginia

Geographic Coverage: Albemarle/Pamlico estuarine areas

Source and Currency

- DEHNR-DMF is data source
- Data are in annual update cycle

Expected Frequency of Use: widespread for those federal and state organizations involved in fisheries management including DEHNR-DMF, DEHNR-DEH (Shellfish Sanitation Branch), and NOAA/NMFS as well as researchers investigating productivity of fisheries

Use Restrictions: developers of this data are concerned with assuring the correct use of the data; before the data are used to draw scientific conclusions potential users are requested to contact the DEHNR-DMF for background on data for the sites

Update Frequency: as needed

Items: identification number, type (primary or secondary), county, quad name, subbasin, water body name, water body code, Division of Marine Fisheries district

Special Considerations: none

3.1.27 Shellfish Evaluation Areas

Description

- Polygon data of harvesting areas for oysters, scallops, and clams which may be either opened, restricted, or closed to shellfishing if necessary
- Any area may change over time to/from one of the following categories: open, conditionally approved, restricted, or prohibited
- Areas that are temporarily opened or closed are not included in this data
- Mapped at a scale of 1:24,000
- Latitude/longitude coordinates are of limited utility to current data users, locations of channel markers would be more useful

Data Condition

- Digital, resident at CGIA
- Need comparable cartographic data for Virginia

Geographic Coverage: Albemarle/Pamlico estuarine areas

Source and Currency

- DEHNR-DMF defines the areas and DEHNR-DEH (Shellfish Sanitation Branch) has the authority to open and close the areas
- Area closings are kept current throughout the year with new openings and closings announced through "polluted area proclamations"

Expected Frequency of Use: widespread by state and federal resource management organizations responsible for fisheries

Use Restrictions: none

Update Frequency: as needed

Items: identification number, county, quad name, subbasin, Shellfish Proclamation Area identifier, DEHNR-DEM water quality classification, description

Special Considerations: integration with 1:100,000-scale hydrography data is desirable; multi-scale representation of the shoreline requires additional consideration during implementation of the A/P Study Database; a special shoreline may be required to map these areas and store them in a manner suitable for users of this data

3.1.28 Oyster Producing Areas

Description

- Polygon data defining areas of oyster production
- Mapped at a scale of 1:24,000

Data Condition

- Digital, resident at CGIA
- Need comparable cartographic data for Virginia

Geographic Coverage: North and central areas of North Carolina coast (all waters south of the White Oak River are designated as oyster producing areas)

Source and Currency

- DEHNR-DMF is data source for digital data currently at CGIA
- Existing data are current through 1983
- Duke University Marine Laboratory is producing additional data and using some DEHNR-DMF data as a subset

Expected Frequency of Use: frequent by the state and federal resource management organizations responsible for fisheries including DEHNR Division of Marine Fisheries, DEHNR Division of Environmental Health (Environmental Health Services Section, Shellfish Sanitation Branch), and NOAA/National Marine Fisheries Service

Use Restrictions: developers of this data are concerned with assuring the correct use of the data; before the data are used to draw scientific conclusions potential users are requested to contact the DEHNR-DMF for background on data for the sites

Update Frequency: as needed

Items: area identifier, county, quad name, subbasin, water body name, water body code

Special Considerations: none

3.1.29 Outstanding Resource Waters

Description

- Polygon and line data describing areas which are proposed for designation as sensitive waters requiring special environmental protection

- Mapped at a scale of 1:24,000

Data Condition

- Non-digital
- Mapped areas need to be digitized

Geographic Coverage: Albemarle/Pamlico estuarine areas

Source and Currency

- DEHNR-DEM (Water Quality Planning Section) is data source
- Current USGS maps were used for mapping

Expected Frequency of Use: average

Use Restrictions: none

Update Frequency: as needed

Items: identification number, general land use, CAMA permit information, county, quad name, subbasin

Special Considerations: none

3.1.30 1970 Census Boundaries

Description

- Polygon data of boundaries used to collect and tabulate socioeconomic data for the 1970 Decennial Census
- Original data maintained at a scale of 1:126,720

Data Condition

- Digital, resident at CGIA
- Virginia 1970 census boundaries need to be obtained

Geographic Coverage: Statewide for North Carolina

Source and Currency

- Bureau of the Census is data source
- Data are post-1970 Census information

Expected Frequency of Use: frequent

Use Restrictions: none

Update Frequency: none

Items: identification number, county, quad name, subbasin, census geography (many other items exist as part of attribute data sets)

Special Considerations: problems exist with consistency of current data at CGIA; some counties contain census tracts and enumeration districts while others only contain census tracts; no one-to-one correspondence from CGIA holdings to census tapes

3.1.31 Artificial Reefs

Description

- Point data representing man-made ridges of rocks or other materials at or near the surface of the water

Data Condition

- Digital, resident at CGIA
- Need comparable cartographic data for Virginia

Geographic Coverage: Coastal North Carolina

Source and Currency

- DEHNR-DMF is data source
- Data represent current locations

Expected Frequency of Use: infrequent

Use Restrictions: none

Update Frequency: as needed

Items: identification number, type of reef, district, program code, date submerged

Special Considerations: none

3.1.32 CAMA Major Development Permits

Description

- Polygon and/or point data of permit locations authorized through the Coastal Area Management Act (CAMA) which stipulates that permits are required for all development or land disturbing activities within designated areas of environmental concern throughout the 20-county coastal area

Data Condition

- Non-digital
- Mapped areas need to be digitized

Geographic Coverage: Albemarle/Pamlico estuarine areas, coastal North Carolina

Source and Currency

- DEHNR-DCM is data source
- Permits mapped for 1981-83 and 1987-88

Expected Frequency of Use: frequent

Use Restrictions: none

Update Frequency: semi-annually

Items: identification number, county, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: none

3.1.33 General Soils

Description

- Polygon data of soil associations made by generalizing more detailed soil survey maps; each association has a distinct pattern of soils, relief, and drainage
- General soils data mapped for entire country at a scale of 1:250,000 (referred to as the State General Soil Geographic Database (STATSGO))

Data Condition

- Digital, resident at CGIA

Geographic Coverage: Statewide for North Carolina and A/P Study portion of Virginia

Source and Currency

- Soil Conservation Service (SCS) is data source
- Data represent current general soils information

Expected Frequency of Use: average

Use Restrictions: none

Update Frequency: none

Items: soils codes/names/symbols, county, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: none

3.1.34 Transportation

Description

- Linear data consisting of roads, railroads, trails, pipelines, canals, power transmission lines, bridges, and tunnels
- Layer exists at scales of 1:24,000 and 1:100,000

Data Condition

- Partially digital, resident at CGIA
- CGIA has complete, digital USGS 1:100,000-scale DLG data (21 maps) for North Carolina
- DLGs at 1:24,000-scale need to be obtained for the A/P Study portion of North Carolina
- Virginia data need to be obtained either in map or digital form, probably as 1:100,000-scale DLGs

Geographic Coverage: Statewide at 1:100,000-scale for North Carolina, partial at 1:24,000-scale for North Carolina; none for Virginia at either scale

Source and Currency

- USGS has a long standing commitment to produce DLG data for the entire country at scales of 1:24,000 and 1:100,000 (transportation is one layer of the DLG effort)

- DLG data at 1:100,000-scale have been scanned by the USGS in 1986 and 1987 while digitization at 1:24,000-scale began in 1982
- Data currency varies among the quads at each scale

Expected Frequency of Use: frequent

Use Restrictions: none

Update Frequency: annually

Items: DLG major and minor codes (road type, type of route, and route number), county, quad name, subbasin

Special Considerations: external edgematching between adjacent map sheets has not been completed for 1:24,000 nor 1:100,000 files; the 1:100,000-scale files will be the base data for the Transportation data

3.1.35 State Park Boundaries

Description

- Polygon data defining all state parks, recreation areas, natural and scenic rivers, trails, state natural areas, state lakes, and nature preserves
- Mapped at a scale of 1:24,000

Data Condition

- Digital, resident at CGIA
- Virginia state park boundaries need to be obtained

Geographic Coverage: Statewide for North Carolina

Source and Currency

- DEHNR-DPR is data source
- Data are current through 1989

Expected Frequency of Use: frequent

Use Restrictions: none

Update Frequency: as needed

Items: identification number, type, name, county, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: overlap areas exist in current digital file where multiple agencies claim same area

3.1.36 Stream-Gaging Stations

Description

- Point data describing the locations of all continuous-record stream-gaging stations and including water discharge as well as water quality information
- Data are included in the USGS WATer Data STORage and REtrieval System (WATSTORE)

Data Condition

- Digital, obtainable by CGIA
- Virginia stream-gaging stations need to be obtained

Geographic Coverage: Statewide for North Carolina

Source and Currency

- USGS, Water Resources Division is data source but DEHNR-DWR also has station locations in digital form
- Gaging station locations are constant, parameter data are collected hourly

Expected Frequency of Use: average

Use Restrictions: none

Update Frequency: none

Items: station number, county, quad name, subbasin, drainage area (other related items appear in an attribute data set)

Special Considerations: none

3.1.37 Marinas

Description

- Point data of locations providing secure moorings for sailboats, motorboats, and yachts
- Roughly mapped version exists but no latitude/longitude coordinates are maintained (location is limited to state road number)

Data Condition

- Non-digital
- New mapping required on USGS 1:100,000-scale stable base material
- Need comparable cartographic data for Virginia

Geographic Coverage: None in digital form

Source and Currency

- DEHNR-DEH (Shellfish Sanitation Branch) is data source
- Information about each marina is kept current by the Shellfish Sanitation Branch since they have authority to close marinas if necessary

Expected Frequency of Use: average

Use Restrictions: none

Update Frequency: as needed

Items: identification number, Shellfish Sanitation Area code,state road number, county, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: none

3.1.38 Peat Lands

Description

- Polygon data identifying areas formed by the partial decay of plants in wet ground, pieces of which are cut and dried and used for fuel
- Mapped at a scale of 1:24,000

Data Condition

- Digital, resident at CGIA
- Need comparable cartographic data for Virginia

Geographic Coverage: Dare, Hyde, Tyrrell, and Washington counties in North Carolina

Source and Currency

- Ingram and Otte study of peat resources is data source
- Data are current through 1982

Expected Frequency of Use: infrequent

Use Restrictions: none

Update Frequency: as needed

Items: thickness of deposit, county, quad name, subbasin

Special Considerations: digital coverage exists in COMARC GIS format; data must be converted to ARC/INFO; data are integrated with 1:24,000-scale shoreline

3.1.39 Anadromous Fish Areas

Description

- Polygonal and point data defining spawning areas and nursery areas, respectively
- Mapped at a scale of 1:24,000

Data Condition

- Digital, resident at CGIA
- Need comparable cartographic data for Virginia

Geographic Coverage: Coastal North Carolina

Source and Currency

- DEHNR-DMF is data source
- Data are current through 1983

Expected Frequency of Use: infrequent

Use Restrictions: developers of this data are concerned with assuring the correct use of the data; before the data are used to draw scientific conclusions potential users are requested to contact the DEHNR-DMF for background on data for the sites

Update Frequency: as needed

Items: county, quad name, water body, subbasin (other related items appear in an attribute data set)

Special Considerations: none

3.1.40 Public Water Supplies (Groundwater Intakes)

Description

- Point data describing locations of surface water supplies and wells serving a specific population
- Over 2,900 community and 8,000 non-community public water supplies exist for North Carolina
- Mapped onto DOT county maps at a scale of 1:126,720

Data Condition

- Digital, obtainable by CGIA
- Latitude/longitude coordinates are being verified with EPA Region IV
- Community water supplies have more accurate coordinate locations than non-community supplies
- Need comparable cartographic data for Virginia

Geographic Coverage: Statewide for North Carolina

Source and Currency

- DEHNR-DEH (Public Water Supply Section) is data source
- Data are current with updates ongoing

Expected Frequency of Use: infrequent

Use Restrictions: none

Update Frequency: annually

Items: water system, well identification number/code, county, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: none

3.1.41 Solid Waste Facilities

Description

- Point data of all locations of landfills and permit information pertaining to them

Data Condition

- Not mapped
- Locations are currently stored as addresses; mapping and digitization need to be performed
- Need comparable cartographic data for Virginia

Geographic Coverage: None in digital form

Source and Currency

- DEHNR-DSWM is data source
- Data currency ranges from 1970s to the present

Expected Frequency of Use: frequent

Use Restrictions: none

Update Frequency: annually

Items: identification number, county, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: none

3.1.42 Aquifers

Description

- Polygon data of subsurface water locations
- Mapped onto DOT county maps at a scale of 1:126,720

Data Condition

- Non-digital
- Mapped areas need to be digitized
- Need comparable cartographic data for Virginia

Geographic Coverage: None in digital form

Source and Currency

- DEHNR-DEM (Groundwater Section) is data source
- Currency of the mapped data needs to be examined

Expected Frequency of Use: average

Use Restrictions: none

Update Frequency: as needed

Items: name or identifier, county, quad name, subbasin

Special Considerations: none

3.1.43 Detailed Soils

Description

- Polygon data derived from maps of soil series, which are the lowest level of soil delineation in the U.S. scheme of classification; each series has soil of unique color, texture, structure, reaction, consistency, and mineral and chemical composition
- Soil survey mapping performed at a scale of 1:24,000 on a county by county basis

Data Condition

- Partially digital, resident at CGIA
- Digital detailed soils data exist for eight of the 36 A/P Study counties
- Remaining 28 counties require soil surveys and digitization
- Virginia detailed soils data need to be obtained

Geographic Coverage: Portions of North Carolina

Source and Currency

- SCS is data source for detailed soils maps for counties where surveys are complete
- Data currency varies among the complete detailed soil surveys

Expected Frequency of Use: frequent

Use Restrictions: none

Update Frequency: as needed

Items: soil codes/names/symbols, county, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: none

3.1.44 Municipal Boundaries

Description

- Polygon data delineating corporate limits of cities and towns

Data Condition

- Digital, resident at CGIA
- Updates needed to reflect new annexations since initial digitization
- DLG 1:2,000,000-scale county data for Virginia has municipal boundaries for large cities
- Virginia municipal boundary data for smaller cities and towns need to be obtained

Geographic Coverage: Statewide for North Carolina

Source and Currency

- DOT maps from 1988 are data source for existing data
- Bureau of the Census TIGER files are an alternative source for updates
- Data are current through 1988

Expected Frequency of Use: widespread as base data

Use Restrictions: none

Update Frequency: annually

Items: county name, FIPS county code, municipal boundary number, city name (other related items appear in an attribute data set)

Special Considerations: none

3.1.45 Pollution Incidents

Description

- Point data representing locations where chemical spills and leaks have occurred along with impacts of each incident

Data Condition

- Digital, in an external data set by CGIA
- Latitude/longitude coordinates need to be verified

- Need comparable cartographic data for Virginia

Geographic Coverage: Statewide for North Carolina

Source and Currency

- DEHNR-DEM (Groundwater Section) is data source
- Incidents are maintained on frequent basis with hundreds of incidents added per year

Expected Frequency of Use: frequent

Use Restrictions: none

Update Frequency: annually

Items: identification number, county, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: none

3.1.46 Ambient Air Monitoring Sites

Description

- Point data of locations for which air pollutant data are recorded on a daily basis for eventual analysis

Data Condition

- Digital, in an external data set obtainable by CGIA
- Latitude/longitude coordinates need to be verified
- Need comparable cartographic data for Virginia

Geographic Coverage: Statewide for North Carolina

Source and Currency

- DEHNR-DEM (Air Quality Section) is data source
- Data represent current sites

Expected Frequency of Use: infrequent

Use Restrictions: none

Update Frequency: annually

Items: identification number, county, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: none

3.1.47 Air Quality Permits

Description

- Point data of locations where air quality permits have been issued for any air contaminant source including equipment that may result in emissions of air contaminants or is likely to cause air pollution or for construction of any air-cleaning device

Data Condition

- Digital, in an external data set obtainable by CGIA
- Universal transverse mercator (UTM) coordinates need to be verified
- Need comparable cartographic data for Virginia

Geographic Coverage: Statewide for North Carolina

Source and Currency

- DEHNR-DEM (Air Quality Section) is data source
- Data currency ranges from the 1970s to the present

Expected Frequency of Use: average

Use Restrictions: none

Update Frequency: annually

Items: identification number, county, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: none

3.1.48 Air Emissions Inventory

Description

- Point data of locations of all air pollution emitters with estimated, measured, and allowable emissions levels maintained

Data Condition

- Digital, in an external data set obtainable by CGIA
- UTM coordinates need to be verified
- Need comparable cartographic data for Virginia

Geographic Coverage: Statewide for North Carolina

Source and Currency

- DEHNR-DEM (Air Quality Section) is data source
- Data are maintained on a frequent basis with new facilities added periodically

Expected Frequency of Use: average

Use Restrictions: none

Update Frequency: annually

Items: identification number, county, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: none

3.1.49 Water Quality Sample Project Locations

Description

- Point data representing the master set of locations where water quality samples have been taken for research purposes and recorded in either digital or non-digital form
- Coverage will be for the entire A/P Study area in North Carolina where water quality samples are being collected or have been collected in the past

Data Condition

- Future cartographic data
- Partially digital, in an external data set obtainable by CGIA
- Mapping may be required for some research data sets while latitude/longitude coordinate values need to be verified for others
- Virginia research efforts and data sets need to be identified

Geographic Coverage: Albemarle/Pamlico estuarine areas

Source and Currency

- Many data sources exist including current and previous university researchers and state and federal agencies
- Data currency ranges from 1955 to the present

Expected Frequency of Use: frequent

Use Restrictions: some researchers may request that they be notified prior to use of their data

Update Frequency: as needed

Items: identification number, county, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: none

3.1.50 Mining Permits

Description

- Point data of locations where mining permits have been issued for any land disturbing activity that affects one or more acres of land and is conducted to accomplish breaking surface soils to extract or remove minerals, ores, or other solid matter, or the preparation, washing, cleaning, or other treatment of such materials to make them suitable for commercial, industrial, or construction use

Data Condition

- Partially digital, in an external data set obtainable by CGIA
- Latitude/longitude coordinates are available for some permit locations; remaining locations need to be mapped
- Need comparable cartographic data for Virginia

Geographic Coverage: Portions of North Carolina

Source and Currency

- DEHNR-DLR (Land Quality Section) is data source
- Data are current with new permit locations added periodically

Expected Frequency of Use: infrequent

Use Restrictions: none

Update Frequency: semi-annually

Items: identification number, type, county, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: none

3.1.51 Lease Blocks

Description

- Polygon (rectangular) data of boundaries used for leasing submerged land
- Lease blocks under federal jurisdiction are outside the three-mile state territorial limit while those under state jurisdiction lie inland from the Outer Banks

Data Condition

- Digital, resident at CGIA
- Plans are under way to acquire the Virginia protraction diagrams

Geographic Coverage: Coastal and offshore North Carolina

Source and Currency

- U.S. Department of the Interior, Minerals Management Service is data source
- Outer Continental Shelf (OCS) Official Protraction Diagrams and the North Carolina Submerged Land Leases Protraction Diagrams were used to create lease block data
- Data represent current lease block designations

Expected Frequency of Use: infrequent

Use Restrictions: none

Update Frequency: as needed

Items: lease block numbers, management code (state or federal), county, quad name

Special Considerations: none

3.1.52 Geology

Description

- Polygon and line data delineating surface geology units; data includes geologic type, faults, sills, and dikes
- Data compiled at a scale of 1:250,000

Data Condition

- Digital, resident at CGIA
- Minor edits need to be performed before entry into the A/P Study Database
- Geological Survey is currently mapping the state at a scale of 1:100,000; this effort should be monitored for future integration into the A/P Study Database
- Virginia geology data need to be obtained

Geographic Coverage: Statewide for North Carolina

Source and Currency

- DEHNR-DLR (Geological Survey Section) is data source for maps that were used to digitize the geology data
- Data are current through 1984

Expected Frequency of Use: average

Use Restrictions: none

Update Frequency: none

Items: geologic type, county, quad name, subbasin

Special Considerations: none

3.1.53 Geodetic Control Points

Description

- Point data of horizontal and vertical control locations
- Horizontal locations refer to latitude and longitude of permanent markers (monuments) surveyed and fixed by the N.C. Geodetic Survey, based on North American Datum 1983 geodetic network and used as a base for mapping

- Vertical locations refer to position above sea level of permanent markers (benchmarks) surveyed and fixed by the N.C. Geodetic Survey, based on National Geodetic Vertical Datum 1929 geodetic network
- Over 25,000 points statewide for North Carolina (12,000-13,000 are vertical)
- Data plotted on 1:63,360-scale source material

Data Condition

- Digital, obtainable by CGIA
- Need comparable cartographic data for Virginia

Geographic Coverage: Statewide for North Carolina

Source and Currency

- DEHNR-DLR (Geodetic Survey Section) is data source
- Data are updated daily

Expected Frequency of Use: infrequent

Use Restrictions: none

Update Frequency: annually

Items: identification number, description, elevation, county, quad name, subbasin

Special Considerations: none

3.1.54 Sea Turtle Population

Description

- Point data based on survey of sea turtle sightings
- Locations have been recorded in latitude/longitude

Data Condition

- Digital, in an external data set obtainable by CGIA
- Latitude/longitude coordinates need to be verified
- Need comparable cartographic data for Virginia

Geographic Coverage: Coastal North Carolina

Source and Currency

- WRC is data source; NOAA/NMFS is collecting sea turtle sightings as well

- Data are produced as a result of an ongoing, yearly survey

Expected Frequency of Use: infrequent

Use Restrictions: none

Update Frequency: as needed

Items: species, county, quad name (other related items appear in an attribute data set)

Special Considerations: none

3.1.55 Ocean Fishing Pier Licenses

Description

- Point data of locations of fishing piers licensed by the DEHNR Division of Marine Fisheries

Data Condition

- Not mapped
- Locations are currently stored as addresses; mapping and digitization need to be performed
- Need comparable cartographic data for Virginia

Geographic Coverage: Coastal North Carolina

Source and Currency

- DEHNR-DMF is data source
- Data consist of yearly registration information

Expected Frequency of Use: infrequent

Use Restrictions: none

Update Frequency: annually

Items: identification number, county, quad name (other related items appear in an attribute data set)

Special Considerations: none

3.1.56 Military Air Space

Description

- Polygon data consisting of extent of air space at various altitudes expressed as "floor" and "ceiling" values
- Mapped at a scale of 1:250,000

Data Condition

- Digital, resident at CGIA
- Updates exist which are not currently represented in the digital files
- Water surface restricted areas are being defined in cooperation with the U.S. Army Corps of Engineers
- Need comparable cartographic data for Virginia

Geographic Coverage: Portions of North Carolina

Source and Currency

- DEHNR-DPA is data source
- Some data were generated from latitude/longitude locations defined by the Department of Defense
- Data are current through 1987

Expected Frequency of Use: average

Use Restrictions: none

Update Frequency: as needed

Items: name or identifier, county, quad name, floor altitude, ceiling altitude, status (existing or proposed)

Special Considerations: none

3.1.57 Fishing Water Jurisdictions

Description

- Linear data that differentiates jurisdiction of North Carolina fishing waters as either inland, inland/joint, inland/coastal, or joint/coastal
- Mapped at a scale of 1:24,000

Data Condition

- Digital, resident at CGIA
- Need comparable cartographic data for Virginia

Geographic Coverage: Statewide for North Carolina

Source and Currency

- WRC is data source
- Data are current through 1983

Expected Frequency of Use: infrequent

Use Restrictions: none

Update Frequency: none

Items: category, county, quad name, subbasin

Special Considerations: digital coverage currently exists in COMARC GIS; data must be converted to ARC/INFO

3.1.58 Historic and Archaeological Sites, Buildings, and Structures

Description

- Point data representing sites of historic, architectural, or archaeological significance including districts, objects, and submerged or terrestrial archaeological sites
- Over 30,000 sites, buildings, and structures exist and are mapped at scale of 1:24,000

Data Condition

- Partially digital, in an external data set obtainable by CGIA
- UTM coordinates need to be verified
- Need comparable cartographic data for Virginia

Geographic Coverage: Portions of North Carolina

Source and Currency

- DCR-DAH (Archaeology and Historic Preservation Section) is data source
- Data represent current identified sites, buildings, and structures

Expected Frequency of Use: average, but greater use expected when looking at impacts of proposed development

Use Restrictions: state and federal laws exist restricting disclosure of information about these sites

Update Frequency: annually

Items: site number, county, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: potential for accuracy problems in UTM coordinate values

3.1.59 Water Quality Monitoring Sites (Groundwater)

Description

- Point data of locations where basic water quality parameters are collected along with concentrations of over 20 chemicals
- Mapping base will be 1:24,000-scale USGS topographic maps

Data Condition

- Not mapped
- Mapping and digitization required
- Need comparable cartographic data for Virginia

Geographic Coverage: None in digital form

Source and Currency

- DEHNR-DEM (Groundwater Section) is data source
- Samples are taken periodically each year and maintained

Expected Frequency of Use: frequent

Use Restrictions: none

Update Frequency: annually

Items: identification number, county, quad name, subbasin (over 30 chemicals sampled for each location to be stored in an attribute data set)

Special Considerations: none

3.1.60 Water Level Monitoring Sites (Groundwater)

Description

- Point data of well locations and information related to the water level of each
- Locations are recorded in a tabular form; these need to be plotted on a base map for verification
- Data are also stored within STORET database

Data Condition

- Digital, in an external data set obtainable by CGIA
- Latitude/longitude or State Plane coordinates need to be verified
- Need comparable cartographic data for Virginia

Geographic Coverage: Statewide for North Carolina

Source and Currency

- DEHNR-DEM (Groundwater Section) is data source
- Data are current and constantly being updated

Expected Frequency of Use: average

Use Restrictions: none

Update Frequency: annually

Items: identification number, county, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: both latitude/longitude and State Plane coordinates are maintained for this cartographic data

3.1.61 Dam Inventory

Description

- Point locations of permits issued for construction, repair, modification, or removal of a dam greater than 15 feet in height and impoundment capacity greater than 10 acre-feet at the top of the dam
- Mapped at a scale of 1:24,000

Data Condition

- Digital, in an external data set obtainable by CGIA
- Latitude/longitude coordinates need to be verified
- Need comparable cartographic data for Virginia

Geographic Coverage: Statewide for North Carolina

Source and Currency

- DEHNR-DLR (Land Quality Section) is data source
- Data represent current permit and inspection information

Expected Frequency of Use: infrequent

Use Restrictions: none

Update Frequency: semi-annually

Items: identification number, dam type, Land Quality region code, hazard class, county, quad name, subbasin (other related items appear in an attribute data set)

Special Considerations: none

3.1.62 Elevation

Description

- Point and/or line data identifying height above sea level at each x,y-coordinate location
- Some geodetic control points (see paragraph 3.1.53) have an elevation attribute

Data Condition

- Partially digital, obtainable by CGIA
- Digital elevation model (DEM) data are available from USGS at 100-meter resolution and 30-meter resolution

Geographic Coverage: Statewide for North Carolina and Virginia at 100-meter resolution; portions of North Carolina and Virginia at 30-meter resolution

Source and Currency

- USGS is data source, either through topographic maps or DEMs
- Data currency is not an issue for this data

Expected Frequency of Use: probably infrequent unless resolution is sufficient for small area analysis

Use Restrictions: none

Update Frequency: none

Items: elevation (z values)

Special Considerations: none, unless CGIA Interactive Surface Modeling (ISM) software could be used to generate elevation points from digitized contours

3.1.63 Watersheds

Description

- Polygon data defining drainage areas for a river or stream; further subdivision of the Subbasins (see paragraph 3.1.4)

Data Condition

- Future cartographic data
- Not mapped
- Areas need to be mapped and digitized
- Need comparable cartographic data for Virginia

Geographic Coverage: None in digital form

Source and Currency

- Appropriate data source needs to be identified
- Most current data available will be used to develop this cartographic data

Expected Frequency of Use: widespread, as background information

Use Restrictions: none

Update Frequency: none

Items: name or identifier, county, quad name, subbasin

Special Considerations: none

3.1.64 Bathymetry

Description

- Point data representing depths of land below water

Data Condition

- Digital, obtainable by CGIA
- Approximately one million data points for A/P Study area
- Virginia bathymetric data need to be obtained

Geographic Coverage: Albemarle/Pamlico estuarine areas

Source and Currency

- National Ocean Survey; USGS Water Resources Division (Raleigh, North Carolina office) has obtained the portion encompassing the A/P Study
- Data currency ranges from the 1930s through the 1970s

Expected Frequency of Use: average, although the bottom material information could prove very useful

Use Restrictions: none

Update Frequency: none

Items: z-value, bottom material descriptors

Special Considerations: an attempt should be made to work with USGS to transfer A/P Study area data into the GIS since they have it in ARC/INFO format

3.2 Attribute Data

There are numerous sets of attribute data that are important to capture and maintain in the A/P Study Database. These data are associated with the cartographic data described in the previous section. Cartographic and attribute data together constitute a data layer. Most attribute data sets are related to cartographic data that have a detailed spatial representation in the form of coordinate values defining either a point, line, or polygon. Other attribute data sets are spatially referenced in a general manner by a street address or county code, thereby limiting their utility for some spatial analytical operations.

A large number of the attribute data sets are collected on a regular basis that could be accumulated yearly and maintained in the A/P Study Database. Availability of this periodic data offers the A/P Study an opportunity to establish agreements with data producing organizations to obtain data on a scheduled basis, whether it be periodic updates or modifications to existing data. The A/P Study data management program will be responsible for the technical arrangements for obtaining the data. Agreements are also needed to obtain other data sets such as A/P Study research data that are not part of ongoing, long term data capture efforts but are nonetheless important in providing a complete, current database for use in resource management of the A/P Study area. These agreements with researchers often will not require the formality of the longer term, interagency agreements.

The attribute data sets described below are listed in alphabetical order. No implementation priority is implied by this order. Rather, implementation priority is based on the order of the associated cartographic data. The set of items listed with each data set represents the master set of items for that data set. Further design of the A/P Study Database will determine the subset of those items to be implemented in the database. Table 2 is a master list of the attribute data sets.

PARAGRAPH NO.	NAME
3.2.1	1970 Census Data
3.2.2	1980 Census Data
3.2.3	1990 Census Data
3.2.4	Agricultural Output Statistics
3.2.5	Air Emissions Inventory Data
3.2.6	Air Quality Permits Data
3.2.7	Ambient Air Monitoring Data
3.2.8	Ambient Water Quality Monitoring Data
3.2.9	Anadromous Fish Data
3.2.10	Big Game Kill Reports Data
3.2.11	Boat Registrations Data
3.2.12	Boating Access Areas Data
3.2.13	Bottom Sediment Sample Data
3.2.14	Building Permits Data
3.2.15	CAMA Major Development Permits Data
3.2.16	Census of Agriculture
3.2.17	Census of Manufactures/Mineral Industries
3.2.18	Census of Wholesale and Retail Trade
3.2.19	Citizen Water Quality Monitoring Data
3.2.20	Commercial Landings Data
3.2.21	County Business Patterns Data
3.2.22	Dam Inventory Data
3.2.23	Detailed Soils Data
3.2.24	Fish Processing Operations Data
3.2.25	Fisheries Biological Monitoring Data
3.2.26	Furbearer Harvest Data
3.2.27	General Soils Data
3.2.28	Hazardous Waste Facilities Data
3.2.29	Heavy Metal and Organic-Rich Mud Pollutants Data
3.2.30	Historic and Archaeological Data
3.2.31	Marinas Data
3.2.32	Mechanical Harvest of Clams Permits Data
3.2.33	Mining Permits Data
3.2.34	Municipal Data
3.2.35	Mussel Distribution Data
3.2.36	Natural Heritage Inventory Data

TABLE 2 List of Attribute Data

PARAGRAPH NO.	NAME
3.2.37	Ocean Fishing Pier Licenses Data
3.2.38	Operating Unit Survey Data
3.2.39	Outdoor Recreation Facility Inventory Data
3.2.40	Oyster Cultch Plant Data
3.2.41	Oyster, Scallop, and Clam Licenses Data
3.2.42	Pollution Incidents Data
3.2.43	Population Estimates/Projections Data
3.2.44	Pound Net Registrations Data
3.2.45	Public Water Supplies Data (Groundwater Intakes)
3.2.46	Recreational Fishery Statistics
3.2.47	Sea Turtle Population Data
3.2.48	Seafood Dealer Licenses Data
3.2.49	Solid Waste Facilities Data
3.2.50	State Parks Data
3.2.51	Stream-Gaging Data
3.2.52	Striped Bass Reproduction Monitoring Data
3.2.53	Superfund Data
3.2.54	Surface Water Intakes Data
3.2.55	Tourism Expenditures and Employment Data
3.2.56	Vessel Licenses/Permits Data
3.2.57	Water Level Monitoring Data (Groundwater)
3.2.58	Water Quality Data Analysis
3.2.59	Water Quality Monitoring Data (Groundwater)
3.2.60	Water Quality Sample Project Data

TABLE 2 List of Attribute Data (Continued)

3.2.1 1970 Census Data

Description

- Social and economic statistics for the census geographies defined for the 1970 Decennial Census
- 1970 Census Boundaries (paragraph 3.1.30) is the cartographic data with attribute data associated by a census geography identifier

Data Condition

- Digital, resident at CGIA
- Virginia 1970 census data need to be obtained

Source and Currency

- Bureau of the Census is data source
- Data are collected from 1970 Decennial Census surveys

Items: census geography identifier, land area; housing data including structural characteristics, household size, value of housing, vacancy status, and tenure of occupant; population data including migration information, age, citizenship, family and household type, household relationship, place of birth, race, sex, urban/rural, veteran status; occupation, employment, and income data

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.30 as part of the cartographic data discussion

3.2.2 1980 Census Data

Description

- Social and economic statistics for the census geographies defined for the 1980 Decennial Census
- 1980 Census Boundaries (paragraph 3.1.12) is the cartographic data with attribute data associated by a census geography identifier

Data Condition

- Digital, resident at CGIA
- Virginia 1980 census data need to be obtained

Source and Currency

- Bureau of the Census is data source
- Data are collected from 1980 Decennial Census surveys

Items: census geography identifier, land area; housing data including structural characteristics, household size, value of housing, vacancy status, monthly owner housing costs, duration of vacancy, and tenure of occupant; population data including migration information, age, citizenship, ancestry, Spanish origin, family and household type, household relationship, place of birth, race, sex, urban/rural, veteran status; occupation, employment, hours worked per week, and income data

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.12 as part of the cartographic data discussion

3.2.3 1990 Census Data

Description

- Social and economic statistics for the census geographies defined for the 1990 Decennial Census
- 1990 Census Boundaries (paragraph 3.1.16) is the cartographic data with attribute data associated by a census geography identifier

Data Condition

- Not collected
- Attribute data will be collected as part of the 1990 Decennial Census survey process
- Virginia 1990 census data need to be obtained when available in 1991

Source and Currency

- Bureau of the Census is data source
- Data will be collected from 1990 Decennial Census surveys

Update Frequency: as needed

Items: census geography identifier, land area; housing data including structural characteristics, household size, value of housing, vacancy status, monthly owner housing costs, duration of vacancy, and tenure of occupant; population data including migration information, age, citizenship, ancestry, Spanish origin, family and household type, household relationship, place of birth, race, sex, urban/rural, veteran status; occupation, employment, hours worked per week, and income data (all items are

subject to change for the 1990 Decennial Census; those given are from the 1980 Decennial Census)

Geographic Coverage, Expected Frequency of Use, Use Restrictions, and Special Considerations are addressed in paragraph 3.1.16 as part of the cartographic data discussion

3.2.4 Agricultural Output Statistics

Description

- Data set describes production levels of a variety of agricultural commodities on a yearly basis
- County Boundaries (paragraph 3.1.3) is the cartographic data with attribute data associated by a FIPS code

Data Condition

- Digital, obtainable by CGIA
- Need a comparable data set for Virginia

Geographic Coverage: Statewide for North Carolina

Source and Currency

- North Carolina Department of Agriculture (Agricultural Statistics Division) is data source
- Various statistics are available from 1866 to the present, and reported ranging from weekly to yearly

Expected Frequency of Use: average

Use Restrictions: non-disclosure rules may prohibit some data from being released to the public for a commodity having only one producer

Update Frequency: annually

Items: FIPS code, crop production, grain stocks, vegetable production, fruit production, prices received and paid by farmers, hog inventory, egg production, hatchery data, milk production, livestock slaughter data, estimated farm cash receipts by commodity, farm labor, crop growth data, and weather data

Special Considerations: none

3.2.5 Air Emissions Inventory Data

Description

- Air Emissions Inventory attribute data give detailed characteristics of air emissions point sources
- Air Emissions Inventory (paragraph 3.1.48) is the cartographic data with attribute data associated by a facility identification number

Data Condition

- Digital, obtainable by CGIA
- Need a comparable data set for Virginia

Source and Currency

- DEHNR-DEM (Air Quality Section) is data source
- Data are available from 1970 to the present and distributed on a yearly basis

Items: facility identification number, facility name and address, stack data, process information, source classification codes, Air Quality Control Region number, control region, principal product of facility, SIC code, pollutant identification number, point numbers for emission points within a facility, control equipment codes, estimated emissions, measured emissions, and allowable emissions (among many other items)

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.48 as part of the cartographic data discussion

3.2.6 Air Quality Permits Data

Description

- Data set associated with air quality permits and corresponding compliance data collected for those locations
- Air Quality Permits (paragraph 3.1.47) is the cartographic data with attribute data associated by a point identification number

Data Condition

- Digital, obtainable by CGIA
- Need a comparable data set for Virginia

Source and Currency

- DEHNR-DEM (Air Quality Section) is data source
- Data are available from 1974 to the present and distributed on a monthly basis

Items: point identification number, rules that apply to the permit, compliance status, relative size of plant, inspection and permit schedules, various permit and registration numbers, and quantities of some pollutants

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.47 as part of the cartographic data discussion

3.2.7 Ambient Air Monitoring Data

Description

- Measures of air quality parameters associated with the sites at a particular point in time
- Ambient Air Monitoring Sites (paragraph 3.1.46) is the cartographic data with attribute data associated by a point identification number

Data Condition

- Digital, obtainable by CGIA
- Need a comparable data set for Virginia

Source and Currency

- DEHNR-DEM (Air Quality Section) is data source
- Data are available from 1972 to the present, collected daily, and distributed on a quarterly basis

Items: point identification number, street address of site, date, for each parameter (e.g., ozone): name, unit of measure, collection method, analysis method, and sample interval

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.46 as part of the cartographic data discussion

3.2.8 Ambient Water Quality Monitoring Data

Description

- STORET water quality parameter data tied to monitoring sites
- Ambient Water Quality Monitoring Sites (paragraph 3.1.10) and Hydrography (paragraph 3.1.6) are the cartographic data with attribute data associated by a point identification number and a DEM stream classification code, respectively

Data Condition

- Digital, obtainable by CGIA
- Need a comparable data set for Virginia

Source and Currency

- DEHNR-DEM (Water Quality Section) is data source
- Data are available from 1969 to the present, collected daily, and distributed on a monthly basis

Items: point identification number, sample data and time, medium, depth, water temperature, stream flow, chloride, dissolved oxygen, arsenic, boron, and other chemical parameters

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.10 as part of the cartographic data discussion

3.2.9 Anadromous Fish Data

Description

- Spawning and nursery area data for certain species of anadromous fish
- Anadromous Fish Areas (paragraph 3.1.39) is the cartographic data with attribute data associated by a polygon identification number

Data Condition

- Digital, resident at CGIA
- Need a comparable data set for Virginia

Source and Currency

- DEHNR-DMF is data source

- Data are current through 1983

Items: polygon identification number and various species found

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.39 as part of the cartographic data discussion

3.2.10 Big Game Kill Reports Data

Description

- Data set consists of kill statistics produced yearly
- County Boundaries (paragraph 3.1.3) is the cartographic data with attribute data associated by a FIPS code

Data Condition

- Digital, obtainable by CGIA
- Need a comparable data set for Virginia

Geographic Coverage: Statewide for North Carolina

Source and Currency

- WRC is data source
- Data are available from 1939 to the present and produced yearly in summary form

Expected Frequency of Use: average

Use Restrictions: none

Update Frequency: annually

Items: FIPS code, species, weapon, hunter name, hunter address, and source lands

Special Considerations: none

3.2.11 Boat Registrations Data

Description

- Basic statistical data about boats and boat owners
- County Boundaries (paragraph 3.1.3) is the cartographic data with attribute data associated by a FIPS code

Data Condition

- Digital, obtainable by CGIA
- Need a comparable data set for Virginia

Geographic Coverage: Statewide for North Carolina

Source and Currency

- WRC is data source
- Data are produced yearly in summary form

Expected Frequency of Use: average

Use Restrictions: none

Update Frequency: annually

Items: FIPS code, size of boat, address of owner, and duration of registration

Special Considerations: none

3.2.12 Boating Access Areas Data

Description

- Data set describing each boating access area in the estuarine area
- Hydrography (paragraph 3.1.6) is the cartographic data with attribute data associated by a water body code

Data Condition

- Digital, obtainable by CGIA
- Need a comparable data set for Virginia

Geographic Coverage: Statewide for North Carolina

Source and Currency

- WRC is data source
- Data are current and updated as necessary

Expected Frequency of Use: average

Use Restrictions: none

Update Frequency: annually

Items: water body code, description of area

Special Considerations: none

3.2.13 Bottom Sediment Sample Data

Description

- Data set describing the sediment material characteristics at the sample location
- Bottom Sediment Sample Locations (paragraph 3.1.24) is the cartographic data with attribute data associated by a point identification number

Data Condition

- Digital, obtainable by CGIA

Source and Currency

- UNC Institute of Marine Sciences (Principal Investigator: Dr. John Wells) is data source through an A/P Study-funded research project
- Data are available from the 1950s to the present

Items: point identification number, percent calcium carbonate, grain size contours, types of sedimentary structures, other data on sediment type, size, and composition

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.24 as part of the cartographic data discussion

3.2.14 Building Permits Data

Description

- Data set of building activity including housing and various other types of construction
- County Boundaries (paragraph 3.1.3) is the cartographic data with attribute data associated by a FIPS code

Data Condition

- Digital, obtainable by CGIA
- Virginia building permits data need to be obtained

Source and Currency

- Bureau of the Census is data source
- Data are available from 1945 to the present and produced monthly in summary form

Expected Frequency of Use: average

Use Restrictions: none

Update Frequency: annually

Items: FIPS code, housing starts, value, amusement parks and recreation areas, and construction of farm ponds

Special Considerations: none

3.2.15 CAMA Major Development Permits Data

Description

- Data set includes environmental characteristics of the CAMA Major Permit sites
- CAMA Major Development Permits (paragraph 3.1.32) is the cartographic data with attribute data associated by a polygon or point identification number

Data Condition

- Digital, obtainable by CGIA

Source and Currency

- DEHNR-DCM is data source
- Data are available from 1981 to the present and updated daily

Items: polygon/point identification number, project description, site description, AECs involved, existing structures, planned structures, impacted areas, planned use, land and water characteristics, upland development, excavation and fill information, shoreline stabilization information, and comments from permit application review agencies

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.32 as part of the cartographic data discussion

3.2.16 Census of Agriculture

Description

- Agricultural statistics based on survey conducted every five years
- County Boundaries (paragraph 3.1.3) is the cartographic data with attribute data associated by a FIPS code

Data Condition

- Digital, obtainable by CGIA
- Virginia census of agriculture data need to be obtained

Geographic Coverage: Statewide for North Carolina

Source and Currency

- Bureau of the Census is data source
- Data are available from 1840 to the present (collected every five years) and produced in summary form

Expected Frequency of Use: average

Use Restrictions: non-disclosure rules may prohibit some data from being released to the public

Update Frequency: every five years

Items: FIPS code, dollars spent on fertilizer, dollars spent on pesticides, farm acreage, sales and inventory of animals, farm operator characteristics, crop acreage, fruit/nut farm acreage, economic statistics, and land use

Special Considerations: none

3.2.17 Census of Manufactures/Mineral Industries

Description

- Industry statistical data produced every five years
- County Boundaries (paragraph 3.1.3) is the cartographic data with attribute data associated by a FIPS code

Data Condition

- Digital, obtainable by CGIA
- Virginia census of manufactures/mineral industries data needs to be obtained

Geographic Coverage: Statewide for North Carolina

Source and Currency

- Bureau of the Census is data source
- Data are available from 1967 to the present (collected every five years) and produced in summary form

Expected Frequency of Use: average

Use Restrictions: non-disclosure rules may prohibit some data from being released to the public

Update Frequency: every five years

Items: FIPS code, expenditures, employment size of establishments, operating expenses, and value added

Special Considerations: none

3.2.18 Census of Wholesale and Retail Trade

Description

- Statistical data of trade activity produced every five years
- County Boundaries (paragraph 3.1.3) is the cartographic data with attribute data associated by a FIPS code

Data Condition

- Digital, obtainable by CGIA
- Virginia census of wholesale and retail trade data need to be obtained

Geographic Coverage: Statewide for North Carolina

Source and Currency

- Bureau of the Census is data source
- Data are available from 1967 to the present (collected every five years) and produced in summary form

Expected Frequency of Use: average

Use Restrictions: non-disclosure rules may prohibit some data from being released to the public

Update Frequency: every five years

Items: FIPS code, operating expenses, number of establishments, sales in dollars

Special Considerations: none

3.2.19 Citizen Water Quality Monitoring Data

Description

- Data set consists of water quality samples taken regularly for each of 50 sites
- Citizen Water Quality Monitoring Sites (paragraph 3.1.22) is the cartographic data with attribute data associated by an identification number

Data Condition

- Digital, obtainable by CGIA

Source and Currency

- Pamlico-Tar River Foundation is data source
- Data are currently being collected for each of the sample sites

Items: identification number, site description, air temperature, water temperature, turbidity, pH, dissolved oxygen, salinity, nitrate, and phosphate

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.22 as part of the cartographic data discussion

3.2.20 Commercial Landings Data

Description

- Data set providing statistics on species caught in each water body by commercial fishermen
- Hydrography (paragraph 3.1.6) is the cartographic data with attribute data associated by a water body code

Data Condition

- Digital, obtainable by CGIA
- Virginia commercial landings data need to be obtained

Geographic Coverage: Coastal North Carolina

Source and Currency

- NOAA/NMFS is data source
- Data are available from 1880 to the present and are compiled monthly

Expected Frequency of Use: average

Use Restrictions: none

Update Frequency: annually

Items: water body code, species, gear, number of pounds, and value

Special Considerations: none

3.2.21 County Business Patterns Data

Description

- Employment and related data for business and industry
- County Boundaries (paragraph 3.1.3) is the cartographic data with attribute data associated by a FIPS code

Data Condition

- Digital, obtainable by CGIA
- Virginia county business patterns data need to be obtained

Geographic Coverage: Statewide for North Carolina

Source and Currency

- Bureau of the Census is data source
- Data are available from 1964 to the present, compiled yearly, and produced in summary form

Expected Frequency of Use: average

Use Restrictions: none

Update Frequency: annually

Items: FIPS code, type of business, number of establishments, payroll, and employment

Special Considerations: none

3.2.22 Dam Inventory Data

Description

- Data set provides characteristics such as measures of capacity and ownership of each dam included in the inventory
- Dam Inventory (paragraph 3.1.61) is the cartographic data with attribute data associated by an identification number

Data Condition

- Digital, obtainable by CGIA
- Need a comparable data set for Virginia

Source and Currency

- DEHNR-DLR (Land Quality Section) is data source
- Data are available from the 1970s to the present

Items: identification number, dam name, river/stream name, lake area, normal capacity, maximum capacity, normal operating freeboard, normal reservoir elevation, stream height, dam volume, crest length, maximum spillway capacity, dam purpose, downstream town, distance of downstream town from dam, population of downstream town, owner name, owner address, owner phone, engineer name, year construction complete, last inspection date, next inspection date

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.61 as part of the cartographic data discussion

3.2.23 Detailed Soils Data

Description

- Interpretative data from detailed soil classifications derived from soil surveys
- Detailed Soils (paragraph 3.1.43) is the cartographic data with attribute data associated by soil code

Data Condition

- Partially digital, resident at CGIA
- Digital detailed soils data exist for eight of the 36 A/P Study counties
- Remaining 28 counties require soil surveys with attribute data provided to CGIA in digital form
- Virginia detailed soils data need to be obtained

Source and Currency

- SCS is data source for detailed soils data for counties where surveys are complete
- Data currency varies by county; interpretative data are produced as each soil survey is completed

Items: soil code and various interpretative parameters (referred to as SOILS5)

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.43 as part of the cartographic data discussion

3.2.24 Fish Processing Operations Data

Description

- Statistical data concerning operations and employment in the fish processing industry
- County Boundaries (paragraph 3.1.3) is the cartographic data with attribute data associated by a FIPS code

Data Condition

- Digital, obtainable by CGIA
- Virginia fish processing operations data need to be obtained

Geographic Coverage: A/P estuarine areas and coastal North Carolina

Source and Currency

- NOAA/NMFS is data source
- Data are available from 1950 to the present, compiled yearly, and produced in summary form

Expected Frequency of Use: average

Use Restrictions: developers of this data set are concerned with assuring the correct use of the data; before the data are used to draw scientific conclusions potential users are requested to contact NOAA/NMFS for background on the data

Update Frequency: annually

Items: FIPS code, dollar value of operations, number of operations, employment by month, and types of seafood processed

Special Considerations: none

3.2.25 Fisheries Biological Monitoring Data

Description

- Data set captured at the monitoring stations
- Fisheries Biological Monitoring Stations (paragraph 3.1.18) and Hydrography (paragraph 3.1.6) are the cartographic data with attribute data associated by a station identifier and a water body code, respectively

Data Condition

- Digital, resident at CGIA
- Need a comparable data set for Virginia

Source and Currency

- DEHNR-DMF is data source
- Data are current through 1984 with updates gradually being made

Items: station identifier, frequency, "location" (one-character designation), and office

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.18 as part of the cartographic data discussion

3.2.26 Furbearer Harvest Data

Description

- Basic statistics about species types and number harvested

• Heavy Metal and Organic-Rich Mud Pollutants Sample Sites (paragraph 3.1.21) is the cartographic data with attribute data associated by an identification number

Data Condition

• Partially digital, obtainable by CGIA
• Pamlico River data available, Neuse River data being developed, and Albemarle Sound data to be developed in 1990

Source and Currency

• East Carolina University, Department of Geology (Principal Investigator: Dr. Stan Riggs) is data source through an A/P Study-funded research project
• Pamlico River data were collected in 1988; Neuse River and Albemarle Sound data will be collected in 1989 and 1990, respectively

Items: identification number, date of sample, time of sample, water depth, water temperature, salinity, weather, air temperature, core type, bottom description, water content, ash content, grain-size distribution (percentage of clay, silt, and sand), chemical concentrations of 24 different metals

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.21 as part of the cartographic data discussion

3.2.30 Historic and Archaeological Data

Description

• Characteristics concerning the historic significance of each site, building, and structure with data divided between historic and archaeological
• Historic and Archaeological Sites, Buildings, and Structures (paragraph 3.1.58) is the cartographic data with attribute data associated by a site number

Data Condition

• Partially digital, obtainable by CGIA
• Need a comparable data set for Virginia

Source and Currency

• DCR-DAH (Archaeology and Historic Preservation Section) is data source
• Data represent current information for identified sites, buildings, and structures

Items: data for historic sites include: site number, owner information, historic use, architectural data, and environmental data; data for archaeological sites include: site

number, environmental setting, site description, historic only designation, prehistoric artifacts, site evaluation, and site destruction information

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.58 as part of the cartographic data discussion

3.2.31 Marinas Data

Description

- Data set includes ownership, size, and facility characteristics
- Marinas (paragraph 3.1.37) is the cartographic data with attribute data associated by an identification number

Data Condition

- Non-digital
- Need to obtain data in digital form
- Need a comparable data set for Virginia

Source and Currency

- DEHNR-DEH (Shellfish Sanitation Branch) is data source
- Data represent current information with updates in process

Items: identification number, docking facility address, phone, commercial and/or private fishing, number of slips or general docking, DEM classification, nearest DEM sampling location, and water body code

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.37 as part of the cartographic data discussion

3.2.32 Mechanical Harvest of Clams Permits

Description

- Data set includes owner and vessel registration information
- County Boundaries (paragraph 3.1.3) is the cartographic data with attribute data associated by a FIPS code

Data Condition

- Digital, obtainable by CGIA

- Need a comparable data set for Virginia

Geographic Coverage: A/P estuarine areas

Source and Currency

- DEHNR-DMF is data source
- Data are available from 1974 to the present, compiled yearly, and produced in summary form

Expected Frequency of Use: average

Use Restrictions: developers of this data set are concerned with assuring the correct use of the data; before the data are used to draw scientific conclusions potential users are requested to contact DEHNR-DMF for background on the data

Update Frequency: annually

Items: FIPS code, name, address, phone, vessel registration information, gear used, issue date, and expiration date

Special Considerations: none

3.2.33 Mining Permits Data

Description

- Data set consists of characteristics of the mine and the permit governing the activity
- Mining Permits (paragraph 3.1.50) is the cartographic data with attribute data associated by an identification number

Data Condition

- Digital, obtainable by CGIA
- Need a comparable data set for Virginia

Source and Currency

- DEHNR-DLR (Land Quality Section) is data source
- Data are available from 1974 to the present, compiled yearly, and produced in summary form

Items: identification number, application date, issue date, expiration date, permit revision date, owner name, owner address and phone, type of mine, commodity code, status of mine, acres affected, amount of bond, inspections, acreage distribution for different aspects of a site, and before and after land use

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.50 as part of the cartographic data discussion

3.2.34 Municipal Data

Description

- Data set includes basic information about each municipality
- Municipal Boundaries (paragraph 3.1.44) is the cartographic data with attribute data associated by a municipal boundary polygon number

Data Condition

- Digital, resident at CGIA
- Virginia municipal data need to be obtained

Source and Currency

- DOT is data source for existing data
- Bureau of the Census TIGER files are an alternative source for updates
- Data are current through 1986 for some cities

Items: municipal boundary polygon number, population, and area

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.44 as part of the cartographic data discussion

3.2.35 Mussel Distribution Data

Description

- Data set includes the species type and species count at each of the sample locations
- Mussel Distribution (paragraph 3.1.23) is the cartographic data with attribute data associated by an identification number

Data Condition

- Digital, obtainable by CGIA
- Need a comparable data set for Virginia

Source and Currency

- WRC is data source
- Data are being collected as part of an ongoing USFWS-funded effort

Items: identification number, date, substrate, species collected, count of each species collected

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.23 as part of the cartographic data discussion

3.2.36 Natural Heritage Inventory Data

Description

- Data set includes property information about sites represented in the inventory
- Natural Heritage Inventory (paragraph 3.1.11) is the cartographic data with attribute data associated by an element identification number

Data Condition

- Non-digital
- Need to obtain in digital form
- Virginia Natural Heritage Inventory data need to be obtained

Source and Currency

- DEHNR-DPR is data source through an A/P Study-funded research project
- Data are current through 1989

Items: element identification number, occurrence information, site/property information, source of information, managed area, state ranking forms, central support databases, element abstracts, element stewardship abstracts, and real property (natural ecosystems, special wildlife habitats, threatened and endangered plant and animal species)

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.11 as part of the cartographic data discussion

3.2.37 Ocean Fishing Pier Licenses Data

Description

- Data set includes information about the pier, usage, its owner, and financial interests held by others
- Ocean Fishing Pier Licenses (paragraph 3.1.55) is the cartographic data with attribute data associated by an identification number

Data Condition

- Digital, obtainable by CGIA
- Need a comparable data set for Virginia

Source and Currency

- DEHNR-DMF is data source
- Data are available from 1974 to the present, compiled yearly, and produced in summary form

Items: identification number, name of pier, manager, property owner, address of pier, corporate leasehold, persons with financial interests, number of persons utilizing pier in previous fishing season, and number of linear feet pier extends into coastal waters

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.55 as part of the cartographic data discussion

3.2.38 Operating Unit Survey Data

Description

- Data set characterizes fishermen and equipment used
- County Boundaries (paragraph 3.1.3) is the cartographic data with attribute data associated by a FIPS code

Data Condition

- Digital, obtainable by CGIA
- Virginia operating unit survey data need to be obtained

Geographic Coverage: A/P estuarine areas and coastal North Carolina

Source and Currency

- NOAA/NMFS is data source through DEHNR-DMF
- Data are available from 1979 to the present, compiled yearly, and produced in summary form

Expected Frequency of Use: average

Use Restrictions: developers of this data set are mostly concerned with assuring the correct use of the data; before the data are used to draw scientific conclusions it is important that potential users contact NOAA/NMFS for some background on the data

Update Frequency: annually

Items: FIPS code, number of fishermen, quantity of gear used, type of gear used, and designation of commercial or casual fishermen

Special Considerations: none

3.2.39 Outdoor Recreation Facility Inventory Data

Description

- Data set consists of size and categorization of outdoor recreation facilities
- County Boundaries (paragraph 3.1.3) is the cartographic data with attribute data associated by a FIPS code

Data Condition

- Digital, obtainable by CGIA
- Need a comparable data set for Virginia

Geographic Coverage: Statewide for North Carolina

Source and Currency

- DEHNR-DPR is data source
- Data are available from 1971 to the present and maintained on a yearly basis

Expected Frequency of Use: average

Use Restrictions: none

Update Frequency: annually

Items: FIPS code, acreage by categories of land, water, and wetlands; acreage by operator categories of federal, state, and local

Special Considerations: none

3.2.40 Oyster Cultch Plant Data

Description

- Data set consists of codes, counts, and narrative information about the cultch sites
- Oyster Cultch Plant Sites (paragraph 3.1.19) is the cartographic data with attribute data associated by a record number

Data Condition

- Digital, resident at CGIA
- Need a comparable data set for Virginia

Source and Currency

- DEHNR-DMF is data source
- Updates from the 1984 base data have recently been made

Items: record number, year, plant number, plant date, type of material, number of bushels, water body code, and descriptions

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.19 as part of the cartographic data discussion

3.2.41 Oyster, Scallop, and Clam Licenses Data

Description

- Data set characterizes the licensee, equipment used, and species for which the license was issued
- County Boundaries (paragraph 3.1.3) is the cartographic data with attribute data associated by a FIPS code

Data Condition

- Digital, obtainable by CGIA
- Need a comparable data set for Virginia

Geographic Coverage: A/P estuarine areas and coastal North Carolina

Source and Currency

- DEHNR-DMF is data source
- Data are available from 1974 to the present, compiled yearly, and produced in summary form

Expected Frequency of Use: average

Use Restrictions: developers of this data set are concerned with assuring the correct use of the data; before the data are used to draw scientific conclusions potential users are requested to contact DEHNR-DMF for background on the data

Update Frequency: annually

Items: FIPS code, licensee information, use, species, gear information, issuing agent name and identification, issue date, and expiration date

Special Considerations: none

3.2.42 Pollution Incidents Data

Description

- Data set describes the characteristics of each pollution incident potentially affecting groundwater
- Pollution Incidents (paragraph 3.1.45) is the cartographic data with attribute data associated by an identification number

Data Condition

- Digital, obtainable by CGIA
- Need a comparable data set for Virginia

Source and Currency

- DEHNR-DEM (Groundwater Section) is data source
- Data are current and updated on a frequent basis

Items: identification number, incident name, date of incident, date incident reported, action taken, address, region, summary of incident, pollutants involved, amount stored/cost/recovered, vertical migration, horizontal migration, areal extent, threat information, reason for incident, permit number, permit type, ERRIS number, ownership, and operation type

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.45 as part of the cartographic data discussion

3.2.43 Population Estimates/Projections Data

Description

- Data set consisting of various statistics for estimating and projecting population
- County Boundaries (paragraph 3.1.3) is the cartographic data with attribute data associated by a FIPS code

Data Condition

- Digital, obtainable by CGIA
- Need a comparable data set for Virginia

Geographic Coverage: Statewide for North Carolina

Source and Currency

- North Carolina State Data Center is data source
- Data are available from 1965 to the present, compiled yearly, and produced in summary form

Expected Frequency of Use: frequent

Use Restrictions: none

Update Frequency: annually

Items: FIPS code, population by age, race, and sex; automobile registrations; births and deaths; life tables; school enrollment; annexed population or housing units

Special Considerations: none

3.2.44 Pound Net Registrations Data

Description

- Data set consists of owner history and licensing information
- County Boundaries (paragraph 3.1.3) and Hydrography (paragraph 3.1.6) are the cartographic data with attribute data associated by a FIPS code and a water body code, respectively

Data Condition

- Digital, obtainable by CGIA
- Need a comparable data set for Virginia

Geographic Coverage: A/P estuarine areas and coastal North Carolina

Source and Currency

- DEHNR-DMF is data source
- Data are available from 1974 to the present, compiled yearly, and produced in summary form

Expected Frequency of Use: average

Use Restrictions: developers of this data set are concerned with assuring the correct use of the data; before the data are used to draw scientific conclusions potential users are requested to contact DEHNR-DMF for background on the data

Update Frequency: annually

Items: FIPS code, water body code, license number, pound net type, number of pounds, length, issue date, expiration date, discontinued date, discontinued reason, craft custom number, owner name, owner address, owner phone, and agent radio number

Special Considerations: none

3.2.45 Public Water Supplies Data (Groundwater Intakes)

Description

- Data set includes characteristics of each public water supply facility
- Public Water Supplies (paragraph 3.1.40) is the cartographic data with attribute data associated by a well identification number/code

Data Condition

- Digital, obtainable by CGIA
- Need a comparable data set for Virginia

Source and Currency

- DEHNR-DEH (Public Water Supply Section) is data source
- Data are current with updates to the data set ongoing

Items: well identification number/code, well or surface water designation, population served, amount of water being used, and chemicals being tested for

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.40 as part of the cartographic data discussion

3.2.46 Recreational Fishery Statistics

Description

- Data set includes demographic data on fisherman and catch data for each fishing trip
- County Boundaries (paragraph 3.1.3) and Hydrography (paragraph 3.1.6) are the cartographic data with attribute data associated by a FIPS code and water body code, respectively

Data Condition

- Digital, obtainable by CGIA
- Virginia recreational fishery statistics data need to be obtained

Geographic Coverage: Statewide for North Carolina

Source and Currency

- DEHNR-DMF is data source
- Data are available from 1979 to the present, compiled yearly, and produced in summary form

Expected Frequency of Use: average

Use Restrictions: developers of this data set are concerned with assuring the correct use of the data; before the data are used to draw scientific conclusions potential users are requested to contact DEHNR-DMF for background on the data

Update Frequency: annually

Items: FIPS code, water body code; fisherman data including name, address, phone, age, and sex; date of catch, fishing mode, species caught, gear used, and duration of fishing trip

Special Considerations: none

3.2.47 Sea Turtle Population Data

Description

- Data set includes species and nest information
- Sea Turtle Population (paragraph 3.1.54) is the cartographic data with attribute data associated by a record number

Data Condition

- Digital, obtainable by CGIA
- Need a comparable data set for Virginia

Source and Currency

- WRC is data source; NOAA/NMFS is collecting sea turtle sightings as well
- Data are produced as a result of an ongoing, yearly survey

Items: record number, stranding, and nest

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.54 as part of the cartographic data discussion

3.2.48 Seafood Dealer Licenses

Description

- Data set consists primarily of basic licensee information
- County Boundaries (paragraph 3.1.3) is the cartographic data with attribute data associated by a FIPS code

Data Condition

- Digital, obtainable by CGIA
- Need a comparable data set for Virginia

Geographic Coverage: A/P estuarine areas and coastal North Carolina

Source and Currency

- DEHNR-DMF is data source
- Data are available from 1974 to the present, compiled yearly, and produced in summary form

Expected Frequency of Use: average

Use Restrictions: developers of this data set are concerned with assuring the correct use of the data; before the data are used to draw scientific conclusions potential users are requested to contact DEHNR-DMF for background on the data

Update Frequency: annually

Items: FIPS code, licensee name, address, phone, issue date, and expiration date

Special Considerations: none

3.2.49 Solid Waste Facilities Data

Description

- Data set includes characteristics of each facility
- Solid Waste Facilities (paragraph 3.1.41) is cartographic data with attribute data associated by an identification number

Data Condition

- Digital, obtainable by CGIA
- Need a comparable data set for Virginia

Source and Currency

- DEHNR-DSWM is data source
- Data are available from the 1970s to the present

Items: identification number, facility name, permit number, location (state road number, U.S. road number, secondary road number, or city street address), permit issue date, and contact person

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.41 as part of the cartographic data discussion

3.2.50 State Parks Data

Description

- Data set characterizing each park including variety of recreation facilities offered and visitation

• State Park Boundaries (paragraph 3.1.35) is the cartographic data with attribute data associated by an identification number

Data Condition

• Partially digital, resident at CGIA
• Digital holdings include 33 of 52 state parks in North Carolina
• Virginia state parks data need to be obtained

Source and Currency

• DEHNR-DPR is data source
• Data are current through 1984 with yearly updates (e.g., visitation) available

Items: identification number, acreage, recreation facilities available, and visitation counts

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.35 as part of the cartographic data discussion

3.2.51 Stream-Gaging Data

Description

• Data set consists of basic characteristics, water discharge records, and water quality records for each gaging station
• Stream-Gaging Stations (paragraph 3.1.36) is the cartographic data with attribute data associated by a station number

Data Condition

• Digital, obtainable by CGIA
• Virginia stream-gaging data need to be obtained

Source and Currency

• USGS, Water Resources Division is data source but DEHNR-DWR also has station locations in digital form
• Data are available from 1912 to the present, collected hourly, summarized daily, and produced in summary form each year

Update Frequency: quarterly

Items: station number, water discharge data: period of record, gage description, remarks, cooperative organization(s), average discharge, extremes for period of

record, extremes outside period of record, extremes for current year, daily mean discharge values by month; water quality data: date recorded, time of day, medium, depth, stream stage, stream flow, conductivity, pH, water temperature, turbidity, dissolved oxygen, fecal coliform, and various other chemical measures

Geographic Coverage, Expected Frequency of Use, Use Restrictions, and Special Considerations are addressed in paragraph 3.1.36 as part of the cartographic data discussion

3.2.52 Striped Bass Reproduction Monitoring Data

Description

- Data set consisting of three types of monitoring information: stocking data, creel survey data, and abundance and viability of larvae data
- Hydrography (paragraph 3.1.6) is the cartographic data with attribute data associated by a water body code

Data Condition

- Digital, obtainable by CGIA

Geographic Coverage: Roanoke River, Tar River, and Albemarle Sound

Source and Currency

- WRC is data source
- Data are compiled yearly and produced in summary form

Expected Frequency of Use: average

Use Restrictions: none

Update Frequency: as needed

Items: water body code; stocking data including species, count, weight of fish stocked, and date; creel survey data including anglers, hours fished, count, weight, species, size and age of fish caught; and abundance and viability of striped bass larvae data

Special Considerations: none

3.2.53 Superfund Data

Description

- Data set includes descriptive information about the site, status of the site, and contaminants found there
- Superfund Sites (paragraph 3.1.15) is the cartographic data with attribute data associated by a site number

Data Condition

- Digital, obtainable by CGIA
- Virginia Superfund data need to be obtained through EPA Region III or appropriate Virginia agency

Source and Currency

- DEHNR-DSWM is data source
- Data are available from 1988 to the present

Items: site number, site name, address, type of facility, CAS number, site evaluation status, type of contaminants present (organics, metals, acids, bases, cyanide, inorganics), and media contaminated (groundwater, surface water, soils)

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.15 as part of the cartographic data discussion

3.2.54 Surface Water Intakes Data

Description

- Data set consists of characteristics associated with individual surface water intake locations
- Surface Water Intakes (paragraph 3.1.13) is the cartographic data with attribute data associated by a DEM identification number

Data Condition

- Digital, resident at CGIA
- Need a comparable data set for Virginia

Source and Currency

- DEHNR-DEM (Water Quality Section) is data source
- Data are current with some items being verified for accuracy

Items: DEM identification number, number of millions of gallons per day, population served, drainage area

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.13 as part of the cartographic data discussion

3.2.55 Tourism Expenditures and Employment Data

Description

- Data set consists of expenditures and employment statistics associated with tourism
- County Boundaries (paragraph 3.1.3) is the cartographic data with attribute data associated by a FIPS code

Data Condition

- Digital, obtainable by CGIA
- Need a comparable data set for Virginia

Geographic Coverage: Statewide for North Carolina

Source and Currency

- North Carolina Department of Commerce (Travel and Tourism Division) is data source
- Data are available from 1957 to the present, compiled yearly, and produced in summary form

Expected Frequency of Use: average

Use Restrictions: none

Update Frequency: annually

Items: FIPS code, travel expenditure dollars, number of travel-related employees, total private sector employment, and percent of total county employment in travel industry

Special Considerations: none

3.2.56 Vessel Licenses/Permits Data

Description

- Data set includes information about the vessel owner and description of the vessel
- County Boundaries (paragraph 3.1.3) is the cartographic data with attribute data associated by a FIPS code

Data Condition

- Digital, obtainable by CGIA
- Need a comparable data set for Virginia

Geographic Coverage: A/P estuarine areas and coastal North Carolina

Source and Currency

- DEHNR-DMF is data source
- Data available from 1974 to the present, compiled yearly, and produced in summary form

Expected Frequency of Use: average

Use Restrictions: developers of this data set are concerned with assuring the correct use of the data; before the data are used to draw scientific conclusions potential users are requested to contact DEHNR-DMF for background on the data

Update Frequency: annually

Items: FIPS code, license transaction information, vessel owner name, vessel owner address, port where vessel is docked, vessel description, and fishing equipment information

Special Considerations: none

3.2.57 Water Level Monitoring Data (Groundwater)

Description

- Data set for wells include various well description parameters and ownership information
- Water Level Monitoring Sites (paragraph 3.1.60) is the cartographic data with attribute data associated by an identification number

Data Condition

- Digital, obtainable by CGIA
- Need a comparable data set for Virginia

Source and Currency

- DEHNR-DEM (Groundwater Section) is data source
- Data are current and constantly being updated

Items: identification number, serial number, screens, aquifer depth, river basin name/number/code, region, ownership code, use code, static water level depth, mean sea level, elevation, well construction date, well diameter, and available data about the site (e.g., temperature, water quality, resistivity)

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.60 as part of the cartographic data discussion

3.2.58 Water Quality Data Analysis

Description

- Data set describing availability of data related to water quality exclusively in the A/P Study region
- County Boundaries (paragraph 3.1.3) is the cartographic data with attribute data associated by a FIPS code

Data Condition

- Digital, obtainable by CGIA

Source and Currency

- USGS, Water Resources Division is data source through an A/P Study-funded research project
- Data set represents current assessment of data availability and includes data from the 1950s to the present

Expected Frequency of Use: frequent

Use Restrictions: none

Update Frequency: not applicable

Items: FIPS code, number of WATSTORE stations and identifiers, number of STORET stations and identifiers, precipitation, percent land use in different categories, acres of crops, number of livestock, census of population data, and point source discharge data

Special Considerations: none

3.2.59 Water Quality Monitoring Data (Groundwater)

Description

- Data set includes chemical parameters collected for each monitoring site
- Water Quality Monitoring Sites (Groundwater) (paragraph 3.1.59) is the cartographic data with attribute data associated by an identification number

Data Condition

- Digital, obtainable by CGIA
- Need a comparable data set for Virginia

Source and Currency

- DEHNR-DEM (Groundwater Section) is data source
- Data are current and constantly being updated

Items: identification number, date of sample, temperature, pH, and levels of 30 different chemicals

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.59 as part of the cartographic data discussion

3.2.60 Water Quality Sample Project Data

Description

- Data set consists of a master set of parameters collected for any or all water quality research/resource management sampling efforts
- Water Quality Sample Project Locations (paragraph 3.1.49) is the cartographic data with attribute data associated by an identification number

Data Condition

- Future data set
- Partially digital, obtainable by CGIA

- Data compilation is necessary to identify all relevant data and begin to design this data set
- Virginia research efforts and data sets need to be identified

Source and Currency

- Many data sources exist including current and previous university researchers and state and federal agencies
- Data are available from the 1950s to the present

Items: sample site identification number, master set of chemical parameters, responsible organization/individual, frequency of sampling, begin and end dates of sampling

Geographic Coverage, Expected Frequency of Use, Use Restrictions, Update Frequency, and Special Considerations are addressed in paragraph 3.1.49 as part of the cartographic data discussion.

3.3 Bibliographic Data

Bibliographic data represent the third major component of the A/P Study Database. Given below are the specifications for entering various types of bibliographic information into the database. As currently defined, bibliographic data will be maintained for books, published reports, unpublished reports, published proceedings, and journal articles specifically about the A/P Study area.

3.3.1 Books

Each book entered into the bibliographic database will be specified with the following information: author, title, publishing company, place of publication, date of publication, subject area (using three keywords), and geographic coverage represented in the text of the book.

3.3.2 Published Reports

Database entries for published reports will include the following set of information: author, title, publishing organization, place of publication, date of publication, subject area (using three keywords), and the geographic coverage represented in the text of the published report.

3.3.3 Unpublished Reports

Bibliographic data for unpublished reports will be entered into the A/P Study Database according to the following specification: author, title, publishing organization, place of publication, date of publication, subject area (using three keywords), and the geographic coverage included in the report.

3.3.4 Published Proceedings

Published proceedings entries into the A/P Study Database will include the following information: organization, title of proceedings, publishing organization, place of publication, date of publication, subject area (using three keywords), and the geographic coverage of the proceedings article cited.

3.3.5 Journal Articles

Each journal article stored in the bibliographic component of the database will be represented by the following set of information: author, title, publishing company,

place of publication, date of publication, subject area (using three keywords), and the geographic coverage referred to in the article.

3.4 Data Inventory

One of the needs expressed most frequently by resource managers and researchers contacted during the A/P Study data needs assessment effort was for a basic data inventory including data relevant to the study area. Often, these potential A/P Study Database users expressed frustration with not knowing whether a particular type of data set existed that could help them in their research or in their resource management responsibilities. Such knowledge could assist them by saving time and money in data collection and analysis. This data inventory can be viewed as a logical product of the data needs assessment process. The current plan is to compile and produce this inventory after the data requirements document has been completed. For each data set identified during the needs assessment, the following information will be specified:

- data set name
- owner organization
- geographic coverage
- statement of data currency
- digital/non-digital
- contact person, address, and phone number

An attempt will be made to catalog not only those data sets described in the data requirements but also those that are not a part of the requirements as well as other important data such as aerial photography holdings by organization.

APPENDIX A

LIST OF ACRONYMS

A/P Study	Albemarle-Pamlico Estuarine Study
AEC	area of environmental concern
CAMA	Coastal Area Management Act
CGIA	Center for Geographic Information & Analysis
DAH	DCR Division of Archives and History
DCR	North Carolina Department of Cultural Resources
DEHNR	North Carolina Department of Environment, Health, and Natural Resources
DEHNR-DCM	DEHNR Division of Coastal Management
DEHNR-DEH	DEHNR Division of Environmental Health
DEHNR-DEM	DEHNR Division of Environmental Management
DEHNR-DLR	DEHNR Division of Land Resources
DEHNR-DMF	DEHNR Division of Marine Fisheries
DEHNR-DPR	DEHNR Division of Parks and Recreation
DEHNR-DSWM	DEHNR Division of Solid Waste Management
DEHNR-DWR	DEHNR Division of Water Resources
DEHNR-DPA	DEHNR Division of Planning and Assessment
DEM	digital elevation model
DLG	digital line graph
DOT	North Carolina Department of Transportation

EPA	Environmental Protection Agency
FIPS	Federal Information Processing Standard
GIS	geographic information system
LINC	Log In to North Carolina
LRIS	Land Resources Information Service
LUDA	Land Use Data Analysis
NOAA	National Oceanic and Atmospheric Administration
NOAA/NMFS	NOAA/National Marine Fisheries Service
NSW	nutrient sensitive watershed
NWI	National Wetlands Inventory
OCS	Outer Continental Shelf
SCS	Soil Conservation Service
SIC	Standard Industrial Classification
SIPS	State Information Processing Services
STATSGO	State General Soil Geographic Database
STORET	EPA STOrage and RETrieval system for water quality data
TIGER	Topologically Integrated Geographic Encoding and Referencing System
UNC	University of North Carolina
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UTM	universal transverse mercator
WATSTORE	WATer Data STORage and REtrieval

WRC	Wildlife Resources Commission

APPENDIX B

USGS LAND USE CLASSIFICATION SYSTEM

A Land Use and Land Cover Classification System for Use with Remote Sensor Data

By JAMES R. ANDERSON, ERNEST E. HARDY, JOHN T. ROACH, *and* RICHARD E. WITMER

GEOLOGICAL SURVEY PROFESSIONAL PAPER 964

A revision of the land use classification system as presented in U.S. Geological Survey Circular 671

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A LAND USE AND LAND COVER CLASSIFICATION SYSTEM FOR USE WITH REMOTE SENSOR DATA

By JAMES R. ANDERSON, ERNEST E. HARDY, JOHN T. ROACH, and RICHARD E. WITMER

ABSTRACT

The framework of a national land use and land cover classification system is presented for use with remote sensor data. The classification system has been developed to meet the needs of Federal and State agencies for an up-to-date overview of land use and land cover throughout the country on a basis that is uniform in categorization at the more generalized first and second levels and that will be receptive to data from satellite and aircraft remote sensors. The proposed system uses the features of existing widely used classification systems that are amenable to data derived from remote sensing sources. It is intentionally left open-ended so that Federal, regional, State, and local agencies can have flexibility in developing more detailed land use classifications at the third and fourth levels in order to meet their particular needs and at the same time remain compatible with each other and the national system. Revision of the land use classification system as presented in U.S. Geological Survey Circular 671 was undertaken in order to incorporate the results of extensive testing and review of the categorization and definitions.

INTRODUCTION

A modern nation, as a modern business, must have adequate information on many complex interrelated aspects of its activities in order to make decisions. Land use is only one such aspect, but knowledge about land use and land cover has become increasingly important as the Nation plans to overcome the problems of haphazard, uncontrolled development, deteriorating environmental quality, loss of prime agricultural lands, destruction of important wetlands, and loss of fish and wildlife habitat. Land use data are needed in the analysis of environmental processes and problems that must be understood if living conditions and standards are to be improved or maintained at current levels.

One of the prime prerequisites for better use of land is information on existing land use patterns and changes in land use through time. The U.S. Department of Agriculture (1972) reported that during the decade of the 1960's, 730,000 acres (296,000 hectares) were urbanized each year, transportation land uses expanded by 130,000 acres (53,000 hectares) per year, and recreational area increased by about 1 million acres (409,000 hectares) per year. Knowledge of the present distribution and area of such agricultural, recreational, and urban lands, as well as information on their changing proportions, is needed by legislators, planners, and State and local governmental officials to determine better land use policy, to project transportation and utility demand, to identify future development pressure points and areas, and to implement effective plans for regional development. As Clawson and Stewart (1965) have stated:

> In this dynamic situation, accurate, meaningful, current data on land use are essential. If public agencies and private organizations are to know what is happening, and are to make sound plans for their own future action, then reliable information is critical.

The variety of land use and land cover data needs is exceedingly broad. Current land use and land cover data are needed for equalization of tax assessments in many States. Land use and land cover data also are needed by Federal, State, and local agencies for water-resource inventory, flood control, water-supply planning, and waste-water treatment. Many Federal agencies need current comprehensive inventories of existing activities on public lands combined with the existing and changing uses of adjacent private lands to improve the management of public lands. Federal agencies also need land use data to assess the environmental impact resulting from the development of energy resources, to manage wildlife resources and minimize man-wildlife ecosystem conflicts, to make national summaries of land use patterns and changes for national policy formulation, and to prepare environmental impact statements and assess future impacts on environmental quality.

NEED FOR STANDARDIZATION

For many years, agencies at the various governmental levels have been collecting data about land, but for the most part they have worked independently and without coordination. Too often this has meant duplication of effort, or it has been found that data collected for a specific purpose were of little or no value for a similar purpose only a short time later.

There are many different sources of information on existing land use and land cover and on changes that are occurring. Local planning agencies make use of detailed information generated during ground surveys involving enumeration and observation. Interpretation of large-scale aerial photographs also has been used widely (Avery, 1968). In some cases, supplementary information is inferred on the basis of utility hookups, building permits, and similar information. Major problems are present in the application and interpretation of the existing data. These include changes in definitions of categories and data-collection methods by source agencies, incomplete data coverage, varying data age, and employment of incompatible classification systems. In addition, it is nearly impossible to aggregate the available data because of the differing classification systems used.

The demand for standardized land use and land cover data can only increase as we seek to assess and manage areas of critical concern for environmental control such as flood plains and wetlands, energy resource development and production areas, wildlife habitat, recreational lands, and areas such as major residential and industrial development sites.

As the result of long concern about duplication and coordination among Federal, State, and local governments in the collection and handling of various types of data, the United States has already achieved reasonably effective, though not perfect, standardization in some instances, as evidenced by present programs in soil surveys, topographic mapping, collection of weather information, and inventory of forest resources. Recent developments in data processing and remote sensing technology make the need for similar cooperation in land use inventories even more evident and more pressing. Development and acceptance of a system for classifying land use data obtained primarily by use of remote sensing techniques, but reasonably compatible with existing classification systems, are the urgently needed first steps.

This is not the first time that use of remote sensors has been proposed to provide the primary data from which land use and land cover types and their boundaries are interpreted. During the past 40 years several surveys, studies, and other projects have successfully demonstrated that remote sensor data are useful for land use and land cover inventory and mapping. These surveys have contributed to our confidence that land use and land cover surveys of larger areas are possible by the use of remote sensor data bases.

In the mid-1940's, Francis J. Marschner began mapping major land use associations for the entire United States, using aerial photographs taken during the late 1930's and the early 1940's. Marschner produced a set of State land use maps at the scale of 1:1,000,000 from mosaics of the aerial photographs and then compiled a map of major land uses at 1:5,000,000 (Marschner, 1950).

More recently, the States of New York and Minnesota have used remote sensor data for statewide land use mapping. New York's LUNR (Land Use and Natural Resources) Program (New York State Office of Planning Coordination, 1969) employs computer storage of some 50 categories of land use information derived from hand-drafted maps compiled by interpreting 1967–1970 aerial photography. This information can be updated and manipulated to provide numerical summaries and analyses and computer-generated maps (Hardy and Shelton, 1970). Aerial photographs taken in the spring of 1968 and 1969 at an altitude of about 40,000 ft (12,400 m) yielded the data incorporated into the nine categories of the Minnesota Land Use Map, a part of the Minnesota Land Management Information System (Orning and Maki, 1972). Thrower's map (1970) of the Southwestern United States represents the first large-area inventory of land use employing satellite imagery. Imagery from several manned and unmanned missions was used in deriving the general land use map published at a scale of 1:1,000,000.

Remote sensing techniques, including the use of conventional aerial photography, can be used effectively to complement surveys based on ground observation and enumeration, so the potential of a timely and accurate inventory of the current use of the Nation's land resources now exists. At the same time, data processing techniques permit the storage of large quantities of detailed data that can be organized in a variety of ways to meet specific needs.

The patterns of resource use and resource demand are constantly changing. Fortunately, the capability to obtain data about land uses related to resource development is improving because of recent technological improvements in remote sensing equip-

ment, interpretation techniques, and data processing (National Academy of Sciences, 1970).

HISTORICAL DEVELOPMENT OF THE CLASSIFICATION SYSTEM

The needs of Federal agencies for a broad overview of national land use and land cover patterns and trends and environmental values led to the formation of an Interagency Steering Committee on Land Use Information and Classification early in 1971. The work of the committee, composed of representatives from the Geological Survey of the U.S. Department of the Interior, the National Aeronautics and Space Administration (NASA), the Soil Conservation Service of the U.S. Department of Agriculture, the Association of American Geographers, and the International Geographical Union, has been supported by NASA and the Department of the Interior and coordinated by the U.S. Geological Survey (U.S.G.S.).

The objective of the committee was the development of a national classification system that would be receptive to inputs of data from both conventional sources and remote sensors on high-altitude aircraft and satellite platforms, and that would at the same time form the framework into which the categories of more detailed land use studies by regional, State, and local agencies could be fitted and aggregated upward from Level IV toward Level I for more generalized smaller scale use at the national level.

Several classification systems designed for or amenable to use with remote sensing techniques served as the basis for discussion at a Conference on Land Use Information and Classification in Washington, D.C., June 28–30, 1971. This conference was attended by more than 150 representatives of Federal, State, and local government agencies, universities, institutes, and private concerns. On the basis of these discussions, the Interagency Steering Committee then proposed to develop and test a land use and land cover classification system that could be used with remote sensing and with minimal reliance on supplemental information at the more generalized first and second levels of categorization. The need for compatibility with the more generalized levels of land use and land cover categorization in classification systems currently in use was clearly recognized, especially those levels of the Standard Land Use Coding Manual published by the U.S. Urban Renewal Administration and the Bureau of Public Roads (1965), the inventory of Major Uses of Land made every 5 years by the Economic Research Service of the U.S. Department of Agriculture (Frey, 1973), and the national inventory of soil and water conservation needs, initiated in 1956 and carried out for the second time in 1966 by several agencies of the U.S. Departments of Agriculture and Interior (U.S. Department of Agriculture, 1971).

Two land use classification systems initially proposed by James R. Anderson for conference use were designed to place major reliance on remote sensing, although supplementary sources of information were assumed to be available for the more elaborate of the two (Anderson, 1971). The classification system for the New York State Land Use and Natural Resources Inventory, developed mainly at the Center for Aerial Photographic Studies at Cornell University, had been designed for use with aerial photography at 1:24,000 scale, and although devised specifically for New York State, it was adaptable for use elsewhere. To take advantage of the New York experience, Ernest E. Hardy and John T. Roach were invited to collaborate in preparing the definitive framework of the proposed classification. Definitions of land use categories used in New York were carefully reviewed and were modified to make them applicable to the country as a whole. The resulting classification was presented in U.S. Geological Survey Circular 671. Because of his past experience with the Commission on Geographic Applications of Remote Sensing of the Association of American Geographers, Richard E. Witmer was invited to participate with the others in this revision of the classification system.

Attention was given mainly to the more generalized first and second levels of categorization. Definitions for each of the categories on these two levels were subjected to selective testing and evaluation by the U.S.G.S., using data obtained primarily from high-altitude flights as part of the research in connection with the U.S.G.S. Central Atlantic Regional Ecological Test Site (CARETS) Project (28,800 mi^2 or 74,700 km^2), the Phoenix Pilot Project (31,500 mi^2 or 81,500 km^2), and the land use mapping for the Ozarks Regional Commission (72,000 mi^2 or 186,500 km^2).

The work of Pettinger and Poulton (1970) provided valuable insight into the land use mosaic of the Southwestern United States. Some of the categorization for barren land and rangeland suggested by these researchers has been adopted in this land use and land cover classification system.

DESIGNING A CLASSIFICATION SYSTEM FOR USE WITH REMOTE SENSING TECHNIQUES

There is no one ideal classification of land use and land cover, and it is unlikely that one could ever be developed. There are different perspectives in the classification process, and the process itself tends to be subjective, even when an objective numerical approach is used. There is, in fact, no logical reason to expect that one detailed inventory should be adequate for more than a short time, since land use and land cover patterns change in keeping with demands for natural resources. Each classification is made to suit the needs of the user, and few users will be satisfied with an inventory that does not meet most of their needs. In attempting to develop a classification system for use with remote sensing techniques that will provide a framework to satisfy the needs of the majority of users, certain guidelines of criteria for evaluation must first be established.

To begin with, there is considerable diversity of opinion about what constitutes land use, although present use of land is one of the characteristics that is widely recognized as significant for planning and management purposes. One concept that has much merit is that land use refers to, "man's activities on land which are directly related to the land" (Clawson and Stewart, 1965). Land cover, on the other hand, describes, "the vegetational and artificial constructions covering the land surface" (Burley, 1961).

The types of land use and land cover categorization developed in the classification system presented in this report can be related to systems for classifying land capability, vulnerability to certain management practices, and potential for any particular activity or land value, either intrinsic or speculative.

Concepts concerning land cover and land use activity are closely related and in many cases have been used interchangeably. The purposes for which lands are being used commonly have associated types of cover, whether they be forest, agricultural, residential, or industrial. Remote sensing image-forming devices do not record activity directly. The remote sensor acquires a response which is based on many characteristics of the land surface, including natural or artificial cover. The interpreter uses patterns, tones, textures, shapes, and site associations to derive information about land use activities from what is basically information about land cover.

Some activities of man, however, cannot be directly related to the type of land cover. Extensive recreational activities covering large tracts of land are not particularly amenable to interpretation from remote sensor data. For example, hunting is a very common and pervasive recreational use of land, but hunting usually occurs on land that would be classified as some type of forest, range, or agricultural land either during ground survey or image interpretation. Consequently, supplemental information is needed to identify lands used for hunting. Supplemental information such as land ownership maps also is necessary to determine the use of lands such as parks, game refuges, or water-conservation districts, which may have land uses coincident with administrative boundaries not usually discernable by inventory using remote sensor data. For these reasons, types of land use and land cover identifiable primarily from remote sensor data are used as the basis for organizing this classification system. Agencies requiring more detailed land use information may need to employ more supplemental data.

In almost any classification process, it is rare to find the clearly defined classes that one would like. In determining land cover, it would seem simple to draw the line between land and water until one considers such problems as seasonally wet areas, tidal flats, or marshes with various kinds of plant cover. Decisions that may seem arbitrary must be made at times, but if the descriptions of categories are complete and guidelines are explained, the inventory process can be repeated. The classification system must allow for the inclusion of all parts of the area under study and should also provide a unit of reference for each land use and land cover type.

The problem of inventorying and classifying multiple uses occurring on a single parcel of land will not be easily solved. Multiple uses may occur simultaneously, as in the instance of agricultural land or forest land used for recreational activities such as hunting or camping. Uses may also occur alternately, such as a major reservoir providing flood control during spring runoff and generating power during winter peak demand periods. This same reservoir may have sufficient water depth to be navigable by commercial shipping the year round and may additionally provide summer recreational opportunities. Obviously all of these activities would not be detectable on a single aerial photograph. However, interpreters have occasionally related flood-control activities to drawdown easements around reservoirs detectable on imagery acquired during winter low-water levels. Similarly, major locks at water-control structures imply barge or ship traffic, and foaming tailraces indicate power generation. Pleasure-boat marinas, as well as the wakes of the

boats themselves, can be detected on high-altitude photographs. Although each of these activities is detectable at some time using remote sensing, many other multiple-use situations cannot be interpreted with the same degree of success. The example of the reservoir does provide insight into another facet of the problem's solution, however, and that is the possibility and need for acquiring collateral data to aid in the understanding of a multiple-use situation.

The vertical arrangement of many uses above and below the actual ground surface provides additional problems for the land use interpreter. Coal and other mineral deposits under croplands or forests, electrical transmission lines crossing pastures, garages underground or on roofs of buildings, and subways beneath urban areas all exemplify situations which must be resolved by individual users and compilers of land use data.

The size of the minimum area which can be depicted as being in any particular land use category depends partially on the scale and resolution of the original remote sensor data or other data source from which the land use is identified and interpreted. It also depends on the scale of data compilation as well as the final scale of the presentation of the land use information. In some cases, land uses cannot be identified with the level of accuracy approaching the size of the smallest unit mappable, while in others, specific land uses can be identified which are too small to be mapped. Farmsteads, for example, are usually not distinguished from other agricultural land uses when mapping at the more generalized levels of the classification. On the other hand, these farmsteads may well be interpretable but too small to be represented at the final format scale. Analogous situations may arise in the use of other categories.

When maps are intended as the format for presenting land use data, it is difficult to represent any unit area smaller than 0.10 inch (2.54 mm) on a side. In addition, smaller areas cause legibility problems for the map reader. Users of computer-generated graphics are similarly constrained by the minimum size of the computer printout.

CLASSIFICATION CRITERIA

A land use and land cover classification system which can effectively employ orbital and high-altitude remote sensor data should meet the following criteria (Anderson, 1971):

1. The minimum level of interpretation accuracy in the identification of land use and land cover categories from remote sensor data should be at least 85 percent.
2. The accuracy of interpretation for the several categories should be about equal.
3. Repeatable or repetitive results should be obtainable from one interpreter to another and from one time of sensing to another.
4. The classification system should be applicable over extensive areas.
5. The categorization should permit vegetation and other types of land cover to be used as surrogates for activity.
6. The classification system should be suitable for use with remote sensor data obtained at different times of the year.
7. Effective use of subcategories that can be obtained from ground surveys or from the use of larger scale or enhanced remote sensor data should be possible.
8. Aggregation of categories must be possible.
9. Comparison with future land use data should be possible.
10. Multiple uses of land should be recognized when possible.

Some of these criteria should apply to land use and land cover classification in general, but some of the criteria apply primarily to land use and land cover data interpreted from remote sensor data.

It is hoped that, at the more generalized first and second levels, an accuracy in interpretation can be attained that will make the land use and land cover data comparable in quality to those obtained in other ways. For land use and land cover data needed for planning and management purposes, the accuracy of interpretation at the generalized first and second levels is satisfactory when the interpreter makes the correct interpretation 85 to 90 percent of the time. For regulation of land use activities or for tax assessment purposes, for example, greater accuracy usually will be required. Greater accuracy generally will be attained only at much higher cost. The accuracy of land use data obtained from remote sensor sources is comparable to that acquired by using enumeration techniques. For example, postenumeration surveys made by the U.S. Bureau of the Census revealed that 14 percent of all farms (but not necessarily 14 percent of the farmland) were not enumerated during the 1969 Census of Agriculture (Ingram and Prochaska, 1972).

In addition to perfecting new interpretation techniques and procedures for analysis, such as the various types of image enhancement and signature identification, we can assume that the resolution capability of the various remote sensing systems will also

improve. Resolution, or resolving power, of an imaging system refers to its ability to separate two objects some distance apart. In most land use applications, we are most interested in the minimum size of an area which can be recognized as having an interpretable land use or land cover type. Obviously, such a minimum area depends not only on the type and characteristics of the imaging system involved, but pragmatically also on the order of "generation" of the imagery, that is, how far the study image is removed in number of reproduction stages from the original record. The user should refer to the most recent information available in determining the resolution parameters of the system.

The kind and amount of land use and land cover information that may be obtained from different sensors depend on the altitude and the resolution of each sensor. There is little likelihood that any one sensor or system will produce good data at all altitudes. It would be desirable to evaluate each source of remote sensing data and its application solely on the basis of the qualities and characteristics of the source. However, it is common practice to transfer the data to a base map, and no matter what the guidelines are, it is difficult to use a base map without extracting some additional data from such maps. Topographic maps, road maps, and detailed city maps will generally contribute detail beyond the capabilities of the remote sensor data.

The multilevel land use and land cover classification system described in this report has been developed because different sensors will provide data at a range of resolutions dependent upon altitude and scale. In general, the following relations pertain, assuming a 6-inch focal length camera is used in obtaining aircraft imagery.

Classification level	*Typical data characteristics*
I	LANDSAT (formery ERTS) type of data.
II	High-altitude data at 40,000 ft (12,400 m) or above (less than 1:80,000 scale).
III	Medium-altitude data taken between 10,000 and 40,000 ft (3,100 and 12,400 m) (1:20,000 to 1:80,000 scale).
IV	Low-altitude data taken below 10,000 ft (3,100 m) (more than 1:20,000 scale).

Although land use data obtained at any level of categorization certainly should not be restricted to any particular level of user groups nor to any particular scale of presentation, information at Levels I and II would generally be of interest to users who desire data on a nationwide, interstate, or statewide basis. More detailed land use and land cover data such as those categorized at Levels III and IV usually will be used more frequently by those who need and generate local information at the intrastate, regional, county, or municipal level. It is intended that these latter levels of categorization will be developed by the user groups themselves, so that their specific needs may be satisfied by the categories they introduce into the structure. Being able to aggregate more detailed categories into the categories at Level II being adopted by the U.S.G.S. is desirable if the classification system is to be useful. In general, Level II land use and land cover data interface quite effectively with point and line data available on the standard U.S.G.S. topographic maps.

This general relationship between the categorization level and the data source is not intended to restrict users to particular scales, either in the original data source from which the land use information is compiled or in the final map product or other graphic device. Level I land use information, for example, while efficiently and economically gathered over large areas by a LANDSAT type of satellite or from high-altitude imagery, could also be interpreted from conventional large-scale aircraft imagery or compiled by ground survey. This same information can be displayed at a wide variety of scales ranging from a standard topographic map scale, such as 1:24,000 or even larger, to the much smaller scale of the orbital imagery, such as 1:1,000,000. Similarly, several Level II categories (and, in some instances, Level III categories) have been interpreted from LANDSAT data. Presently, though, Level II categories are obtained more accurately from high-altitude photographs. Much Level III and Level IV land use and land cover data can also be obtained from high-altitude imagery. This level of categorization can also be presented at a wide range of scales. However, as the more detailed levels of categorization are used, more dependence necessarily must be placed on higher resolution remote sensor data and supplemental ground surveys.

The principal remote sensor source for Level II data at the present time is high-altitude, color-infrared photography. Scales smaller than 1:80,000 are characteristic of high-altitude photographs, but scales from 1:24,000 to 1:250,000 generally have been used for the final map products.

The same photography which now is used to construct or update 1:24,000 topographic maps or orthophotoquads at similar scales is a potential data source for inventorying land use and land cover. The orthophoto base, in particular, commonly can enable rapid interpretation of Levels I and II information at relatively low cost. The cost of acquiring more detailed levels of land use and land cover data

might prohibit including such data on large-scale maps over extensive areas.

Recent experiments (Stevens and others, 1974) with Levels I and II land use data referenced to 1:24,000 topographic maps have been conducted by researchers of the Maps and Surveys Branch of the Tennessee Valley Authority in conjunction with the Marshall Space Flight Center and Oak Ridge National Laboratories. Quite satisfactory results have been obtained when interpreting land use from high-altitude photography. In areas of considerable terrain relief a stereoplotter was used to avoid scale problems.

The categories proposed at Level II cannot all be interpreted with equal reliability. In parts of the United States, some categories may be extremely difficult to interpret from high-altitude aircraft imagery alone. Conventional aerial photography and sources of information other than remote sensor data may be needed for interpretation of especially complex areas. On the basis of research and testing carried out in the U.S.G.S. Geography Program's Central Atlantic Regional Ecological Test Site (CARETS) Project, the Phoenix Pilot Project, and in land use mapping for the Ozarks Regional Commission (U.S. Geological Survey, 1973), it has been determined that the cost of using such supplementary information can be held to reasonable levels.

At Level III, which is beyond the scope of the present discussion, use of substantial amounts of supplemental information in addition to some remotely sensed information at scales of 1:15,000 to 1:40,000 should be anticipated. Surprisingly detailed inventories may be undertaken, and by using both remotely sensed and supplemental information, most land use and land cover types, except those of very complex urban areas or of thoroughly heterogeneous mixtures can be adequately located, measured, and coded.

Level IV would call for much more supplemental information and remotely sensed data at a much larger scale.

DEVELOPING THE CLASSIFICATION SYSTEM

In developing the classification system, every effort has been made to provide as much compatibility as possible with other classification systems currently being used by the various Federal agencies involved in land use inventory and mapping. Special attention has been paid to the definitions of land use categories used by other agencies, to the extent that they are useful in categorizing data obtained from remote sensor sources.

The definition of Urban or Built-up Land, for example, includes those uses similarly classified (Wooten and Anderson, 1957) by the U.S. Department of Agriculture, plus the built-up portions of major recreational sites, public installations, and other similar facilities. Agricultural land has been defined to include Cropland and Pasture; Orchards, Groves, Vineyards, Nurseries, and Ornamental Horticultural Areas; and Confined Feeding Operations as the principal components. Certain land uses such as pasture, however, cannot be separated consistently and accurately by using the remote sensor data sources appropriate to the more generalized levels of the classification. The totality of the category thus closely parallels the U.S. Department of Agriculture definition of agricultural land.

The primary definition of Forest Land employed for use with data acquired by remote sensors approximates that used by the U.S. Forest Service (unpublished manual), with the exception of those brush and shrub-form types such as chaparral and mesquite, which are classed as forest land by the Forest Service because of their importance in watershed control. Because of their spectral response, these generally are grouped with Rangeland types in classifications of vegetation interpretable from remote sensing imagery.

The principal concept by which certain types of cover are included in the Rangeland category, and which separates rangeland from pasture land, is that rangeland has a natural climax plant cover of native grasses, forbs, and shrubs which is potentially useful as a grazing or forage resource (U.S. Congress, 1936; U.S. Department of Agriculture, 1962, 1971). Although these rangelands usually are not seeded, fertilized, drained, irrigated, or cultivated, if the forage cover is improved, it is managed primarily like native vegetation, and the forage resource is regulated by varying the intensity and seasonality of grazing (Stoddard and Smith, 1955). Since the typical cropland practices mentioned just above are characteristics of some pasture lands, these pasture lands are similar in image signature to cropland types.

The definition of Wetland incorporates the major elements of the original U.S. Department of the Interior definition (Shaw and Fredine, 1956) as well as the combined efforts of the U.S.G.S. working group on wetlands definition.

Table 1 presents a general summary of land use compiled every 5 years by the Economic Research

Service of the U.S. Department of Agriculture and supplemented from other sources. These statistics, which are available only for States, are provided by the various government agencies which compile information on some categories of land use, several of which parallel the U.S.G.S. land use classification system.

TABLE 1.—*Major uses of land, United States, 1969* [1]

	Acres (millions)	Hectares (millions)	Percent
Cropland	472	191	20.9
Cropland used for crops	333	135	---
Cropland harvested	286	116	---
Crop failure	6	2	---
Cultivated summer fallow	41	17	---
Soil improvement crops and idle cropland	51	21	---
Cropland used only for pasture	88	35	---
Grassland pasture and range [2]	604	245	26.7
Forest land	723	293	31.9
Grazed	198	80	---
Not grazed	525	213	---
Special uses [3]	178	72	7.9
Urban areas	35	14	---
Transportation areas	26	11	---
Rural parks	49	19	---
Wildlife refuges	32	13	---
National defense, flood control, and industrial areas	26	11	---
State-owned institutions and miscellaneous other uses	2	1	---
Farmsteads, farm roads, and lanes	8	3	---
Miscellaneous land [4]	287	116	12.6

[1] Frey, H. T., 1973. Does not include area covered by water in streams more than ¼ of a mile in width and lakes, reservoirs, and so forth of more than 40 acres in size.
[2] Includes pasture that is to be included with cropland in the U.S.G.S. classification system.
[3] Except for urban and built-up areas and transportation uses, these special uses will be classified by dominant cover under the U.S.G.S. classification system.
[4] Tundra, glaciers, and icefields, marshes, open swamps, bare rock areas, deserts, beaches, and other miscellaneous land.

The land use and land cover classification system presented in this report (table 2) includes only the more generalized first and second levels. The system satisfies the three major attributes of the classification process as outlined by Grigg (1965): (1) it gives names to categories by simply using accepted terminology; (2) it enables information to be transmitted; and (3) it allows inductive generalizations to be made. The classification system is capable of further refinement on the basis of more extended and varied use. At the more generalized levels it should meet the principal objective of providing a land use and land cover classification system for use in land use planning and management activities. Attainment of the more fundamental and long-range objective of providing a standardized system of land use and land cover classification for national and regional

TABLE 2.—*Land use and land cover classification system for use with remote sensor data*

Level I		Level II	
1	Urban or Built-up Land	11	Residential.
		12	Commercial and Services.
		13	Industrial.
		14	Transportation, Communications, and Utilities.
		15	Industrial and Commercial Complexes.
		16	Mixed Urban or Built-up Land.
		17	Other Urban or Built-up Land.
2	Agricultural Land	21	Cropland and Pasture.
		22	Orchards, Groves, Vineyards, Nurseries, and Ornamental Horticultural Areas.
		23	Confined Feeding Operations.
		24	Other Agricultural Land.
3	Rangeland	31	Herbaceous Rangeland.
		32	Shrub and Brush Rangeland.
		33	Mixed Rangeland.
4	Forest Land	41	Deciduous Forest Land.
		42	Evergreen Forest Land.
		43	Mixed Forest Land.
5	Water	51	Streams and Canals.
		52	Lakes.
		53	Reservoirs.
		54	Bays and Estuaries.
6	Wetland	61	Forested Wetland.
		62	Nonforested Wetland.
7	Barren Land	71	Dry Salt Flats.
		72	Beaches.
		73	Sandy Areas other than Beaches.
		74	Bare Exposed Rock.
		75	Strip Mines, Quarries, and Gravel Pits.
		76	Transitional Areas.
		77	Mixed Barren Land.
8	Tundra	81	Shrub and Brush Tundra.
		82	Herbaceous Tundra.
		83	Bare Ground Tundra.
		84	Wet Tundra.
		85	Mixed Tundra.
9	Perennial Snow or Ice	91	Perennial Snowfields.
		92	Glaciers.

studies will depend on the improvement that should result from widespread use of the system.

As further advances in technology are made, it may be necessary to modify the classification system for use with automatic data analysis. The LANDSAT and Skylab missions and the high-altitude aircraft program of the National Aeronautics and Space Administration have offered opportunities for nationwide testing of the feasibility of using this classification system to obtain land use information on a uniform basis.

The approach to land use and land cover classification embodied in the system described herein is "resource oriented," in contrast, for example, with the "people orientation" of the "Standard Land Use

Coding Manual," developed by the U.S. Urban Renewal Administration and the Bureau of Public Roads (1965). For the most part the Manual is derived from the "Standard Industrial Classification Code" established and published by the former Bureau of the Budget (U.S. Executive Office of the President, 1957).

The people-oriented system of the "Standard Land Use Coding Manual" assigns seven of the nine generalized first level categories to urban, transportation, recreational, and related uses of land, which account for less than 5 percent of the total area of the United States (tables 1 and 3). Although there is an obvious need for an urban-oriented land use classification system, there is also a need for a resource-oriented classification system whose primary emphasis would be the remaining 95 percent of the United States land area. The U.S.G.S. classification system described in this report addresses that need, with eight of the nine Level I categories treating land area of the United States that is not in urban or built-up areas. Six of the first level categories in the standard land use code are retained under Urban or Built-up at Level II in the U.S.G.S. system. Even though the standard land use code and the U.S.G.S. classification differ considerably in their major emphases, a marked degree of compatibility between these two systems exists at the more generalized levels and even at the more detailed levels.

TABLE 3.—*Standard land use code—first level categories*[1]

1. Residential.
2. Manufacturing (9 second level categories included).
3. Manufacturing (6 second level categories included).
4. Transportation, communications, and utilities.
5. Trade.
6. Services.
7. Cultural, entertainment, and recreation.
8. Resource production and extraction.
9. Undeveloped land and water areas.

[1] Standard land use coding manual, 1965, p. 29.

USING THE CLASSIFICATION SYSTEM

The use of the same or similar terminology does not automatically guarantee that the land use data collected and coded according to two systems will be entirely compatible. The principal points of departure between other classifications and the U.S.G.S. system originate because of the emphasis placed on remote sensing as the primary data source used in the U.S.G.S. classification system. Because of this emphasis, activity must be interpreted using land cover as the principal surrogate, in addition to the image interpreter's customary references to pattern, geographic location, and so forth. This process necessarily precludes the possibility of information being generated which identifies ownership-management units such as farms or ranches or relating detached uses, included in a specific ownership complex, to the parent activity. For example, warehouses cannot be related to retail sales when the two occurrences are separated spatially. The actual cover and related uses are mapped in each case, rather than injecting inference into the inventory process.

Inferences used for prediction could cause problems for the land use interpreter where land use is clearly in transition, with neither the former use nor the future use actually being present. In most such cases, it is tempting to speculate on future use, but all that can actually be determined in such wide-ranging situations is that change is occurring. Large clear-cut areas in the southeastern forests, for example, are not always returned to forests and might assume any of a variety of future uses, such as a residential subdivision, an industrial site, an area of cropland, or a phosphate mine. The "sagebrush subdivision" of the Southwest may have all the potential earmarks of future settlement, such as carefully platted streets, and yet never experience any construction. Such cleared open areas should be identified as "Transitional Areas."

Since Level II will probably be most appropriate for statewide and interstate regional land use and land cover compilation and mapping, and since Level II categories can be created by aggregating similar Level III categories, the Level II categorization may be considered to be the fulcrum of the classification system. The classification system may be entered at the particular level appropriate to the individual user, and the information generated may be added together with data generated by others to form an aggregate category at the next higher level. As an example, if a local planning group had devised a Level III classification of a particular group of land uses and had included sufficient definitional information of their land use categories, their data could be compiled into a larger inventory by a state or regional planning group compiling data by use of the Level II categories. Such data, in turn, could serve as part of the data base for a national inventory.

Seldom is it necessary to inventory land uses at the more detailed levels, even for local planning. Having greater detail does, however, provide flexibility in manipulating the data when several different purposes must be served. The cost of interpreting, coding, and recording land use data at the more detailed levels is necessarily greater than if the data were handled at more generalized levels. This extra cost reflects the increase in cost of remote sensor and

collateral data acquired at larger scales, as well as the increase in interpretation costs.

The U.S.G.S. classification system provides flexibility in developing categorization at the more detailed levels. Therefore, it is appropriate to illustrate the additive properties of the system and to provide examples for users wishing to develop more detailed categorization. The several examples given below represent possible categorizations. Users should not consider themselves limited to categories such as these but should develop categories of utmost utility to their particular needs. It should be emphasized that, whatever categories are used at the various classification levels, special attention should be given to providing the potential users of the data with sufficient information so that they may either compile the data into more generalized levels or aggregate more detailed data into the existing classes.

One example of subcategorization of Residential Land as keyed to the standard land use code would be:

Level I	Level II	Level III
1. Urban or Built-up	11. Residential.	111. Single-family Units.
		112. Multi-family Units.
		113. Group Quarters.
		114. Residential Hotels.
		115. Mobile Home Parks.
		116. Transient Lodgings.
		117. Other.

This particular breakdown of "Residential" employs criteria of capacity, type, and permanency of residence as the discriminating factors among classes. Criteria applied to other situations could possibly include density of dwellings, tenancy, age of construction, and so forth. Obviously, such a Level III categorization would require use of supplemental information. Users desiring Level IV information could employ a variety of additional criteria in discriminating among land uses,but it can be seen that the element which allows aggregation and transfer between categories is the proper description of what is included in each individual category at whatever level the data are being classified.

The Level II category, Cropland and Pasture, may be simply subdivided at Level III.

Level II	Level III
21. Cropland and Pasture.	211. Cropland.
	212. Pasture.

Some users may wish such additional criteria employed at Level III as degree of activity or idleness or degree of improvement, while others may place such items in Levels IV or V. What may be a primary category for one user group may be of secondary importance to another. As stated by Clawson and Stewart (1965), "One man's miscellany is another man's prime concern." No one would consider publishing a map of current land use of any part of the Western United States without having irrigated land as a major category. With the flexibility inherent in this classification system, an accommodation of this type of need can be made easily, provided that irrigated land is mapped or tabulated as a discrete unit which can be aggregated into the more general categories included in the framework of the classification. A possible restructuring which would accommodate the desire to present irrigated land as a major category would be:

Irrigated agricultural land	Nonirrigated agricultural land
Cropland	Cropland
Pasture	Pasture
Orchards, Groves and so forth	Orchards, Groves and so forth

DEFINITIONS

An attempt has been made to include sufficient detail in the definitions presented here to provide a general understanding of what is included in each category at Levels I and II. Many of the uses described in detail will not be detectable on small-scale aerial photographs. However, the detail will aid in the interpretation process, and the additional information will be useful to those who have large-scale aerial photographs and other supplemental information available.

1. URBAN OR BUILT-UP LAND

Urban or Built-up Land is comprised of areas of intensive use with much of the land covered by structures. Included in this category are cities, towns, villages, strip developments along highways, transportation, power, and communications facilities, and areas such as those occupied by mills, shopping centers, industrial and commercial complexes, and institutions that may, in some instances, be isolated from urban areas.

As development progresses, land having less intensive or nonconforming use may be located in the midst of Urban or Built-up areas and will generally be included in this category. Agricultural land, forest, wetland, or water areas on the fringe of Urban or Built-up areas will not be included except where they are surrounded and dominated by urban development. The Urban or Built-up category takes precedence over others when the criteria for more than one category are met. For example, residential areas that have sufficient tree cover to meet Forest Land criteria will be placed in the Residential category.

11. RESIDENTIAL

Residential land uses range from high density, represented by the multiple-unit structures of urban cores, to low density, where houses are on lots of more than an acre, on the periphery of urban expansion. Linear residential developments along transportation routes extending outward from urban areas should be included as residential appendages to urban centers, but care must be taken to distinguish them from commercial strips in the same locality. The residential strips generally have a uniform size and spacing of structures, linear driveways, and lawn areas; the commercial strips are more likely to have buildings of different sizes and spacing, large driveways, and parking areas. Residential development along shorelines is also linear and sometimes extends back only one residential parcel from the shoreline to the first road.

Areas of sparse residential land use, such as farmsteads, will be included in categories to which they are related unless an appropriate compilation scale is being used to indicate such uses separately. Rural residential and recreational subdivisions, however, are included in this category, since the land is almost totally committed to residential use, even though it may have forest or range types of cover. In some places, the boundary will be clear where new housing developments abut against intensively used agricultural areas, but the boundary may be vague and difficult to discern when residential development occurs in small isolated units over an area of mixed or less intensive uses. A careful evaluation of density and the overall relation of the area to the total urban complex must be made.

Residential sections which are integral parts of other uses may be difficult to identify. Housing situations such as those existing on military bases, at colleges and universities, living quarters for laborers near a work base, or lodging for employees of agricultural field operations or resorts thus would be placed within the Industrial, Agricultural, or Commercial and Services categories.

12. COMMERCIAL AND SERVICES

Commercial areas are those used predominantly for the sale of products and services. They are often abutted by residential, agricultural, or other contrasting uses which help define them. Components of the Commercial and Services category are urban central business districts; shopping centers, usually in suburban and outlying areas; commercial strip developments along major highways and access routes to cities; junkyards; resorts; and so forth. The main buildings, secondary structures, and areas supporting the basic use are all included—office buildings, warehouses, driveways, sheds, parking lots, landscaped areas, and waste disposal areas.

Commercial areas may include some noncommercial uses too small to be separated out. Central business districts commonly include some institutions, such as churches and schools, and commercial strip developments may include some residential units. When these noncommercial uses exceed one-third of the total commercial area, the Mixed Urban or Built-up category should be used. There is no separate category for recreational land uses at Level II since most recreational activity is pervasive throughout many other land uses. Selected areas are predominantly recreation oriented, and some of the more distinctive occurrences such as drive-in theaters can be identified on remote sensor imagery. Most recreational activity, however, necessarily will be identified using supplemental information. Recreational facilities that form an integral part of an institution should be included in this category. There is usually a major visible difference in the form of parking facilities, arrangements for traffic flow, and the general association of buildings and facilities. The intensively developed sections of recreational areas would be included in the Commercial and Services category, but extensive parts of golf courses, riding areas, ski areas, and so forth would be included in the Other Urban or Built-up category.

Institutional land uses, such as the various educational, religious, health, correctional, and military facilities are also components of this category. All buildings, grounds, and parking lots that compose the facility are included within the institutional unit, but areas not specifically related to the purpose of the institution should be placed in the appropriate category. Auxiliary land uses, particularly residential, commercial and services, and other supporting land uses on a military base would be included in this category, but agricultural areas not specifically associated with correctional, educational, or religious institutions are placed in the appropriate agricultural category. Small institutional units, as, for example, many churches and some secondary and elementary schools, would be mappable only at large scales and will usually be included within another category, such as Residential.

13. INDUSTRIAL

Industrial areas include a wide array of land uses from light manufacturing to heavy manufacturing

plants. Identification of light industries—those focused on design, assembly, finishing, processing, and packaging of products—can often be based on the type of building, parking, and shipping arrangements. Light industrial areas may be, but are not necessarily, directly in contact with urban areas; many are now found at airports or in relatively open country. Heavy industries use raw materials such as iron ore, timber, or coal. Included are steel mills, pulp and lumber mills, electric-power generating stations, oil refineries and tank farms, chemical plants, and brickmaking plants. Stockpiles of raw materials and waste-product disposal areas are usually visible, along with transportation facilities capable of handling heavy materials.

Surface structures associated with mining operations are included in this category. Surface structures and equipment may range from a minimum of a loading device and trucks to extended areas with access roads, processing facilities, stockpiles, storage sheds, and numerous vehicles. Spoil material and slag heaps usually are found within a short trucking distance of the major mine areas and may be the key indicator of underground mining operations. Uniform identification of all these diverse extractive uses is extremely difficult from remote sensor data alone. Areas of future reserves are included in the appropriate present-use category, such as Agricultural Land or Forest Land, regardless of the expected future use.

14. TRANSPORTATION, COMMUNICATIONS, AND UTILITIES

The land uses included in the Transportation, Communications, and Utilities category occur to some degree within all of the other Urban or Built-up categories and actually can be found within many other categories. Unless they can be mapped separately at whatever scale is being employed, they usually are considered an integral part of the land use within which they occur. For that reason, any statistical summary of the area of land uses in this category typically represents only a partial data set. Statistical area summaries of such land uses aggregated from Levels III and IV, though, would include more accurate area estimates.

Major transportation routes and areas greatly influence other land uses, and many land use boundaries are outlined by them. The types and extent of transportation facilities in a locality determine the degree of access and affect both the present and potential use of the area.

Highways and railways are characterized by areas of activity connected in linear patterns. The highways include rights-of-way, areas used for interchanges, and service and terminal facilities. Rail facilities include stations, parking lots, roundhouses, repair and switching yards, and related areas, as well as overland track and spur connections of sufficient width for delineation at mapping scale.

Airports, seaports, and major lakeports are isolated areas of high utilization, usually with no well-defined intervening connections, although some ports are connected by canals. Airport facilities include the runways, intervening land, terminals, service buildings, navigation aids, fuel storage, parking lots, and a limited buffer zone. Terminal facilities generally include the associated freight and warehousing functions. Small airports (except those on rotated farmland), heliports, and land associated with seaplane bases may be identified if mapping scale permits. Port areas include the docks, shipyards, drydocks, locks, and waterway control structures.

Communications and utilities areas such as those involved in processing, treatment, and transportation of water, gas, oil, and electricity and areas used for airwave communications are also included in this category. Pumping stations, electric substations, and areas used for radio, radar, or television antennas are the major types. Small facilities, or those associated with an industrial or commercial land use, are included within the larger category with which they are associated. Long-distance gas, oil, electric, telephone, water, or other transmission facilities rarely constitute the dominant use of the lands with which they are associated.

15. INDUSTRIAL AND COMMERCIAL COMPLEXES

The Industrial and Commercial Complexes category includes those industrial and commercial land uses that typically occur together or in close functional proximity. Such areas commonly are labeled with terminology such as "Industrial Park," but since functions such as warehousing, wholesaling, and occasionally retailing may be found in the same structures or nearby, the more inclusive category title has been adopted.

Industrial and Commercial complexes have a definite remote sensor image signature which allows their separation from other Urban or Built-up land uses. Because of their intentional development as discrete units of land use, they may border on a wide variety of other land use types, from Residential Land to Agricultural Land to Forest Land. If the separate functions included in the category are iden-

tified at Levels III or IV using supplemental data or with ground survey, the land use researcher has the discretion of aggregating these functions into the appropriate Level II Urban or Built-up categories or retaining the unit as an Industrial and Commercial Complex.

16. MIXED URBAN OR BUILT-UP LAND

The Mixed Urban or Built-up category is used for a mixture of Level II Urban or Built-up uses where individual uses cannot be separated at mapping scale. Where more than one-third intermixture of another use or uses occurs in a specific area, it is classified as Mixed Urban or Built-up Land. Where the intermixed land use or uses total less than one-third of the specific area, the category appropriate to the dominant land use is applied.

This category typically includes developments along transportation routes and in cities, towns, and built-up areas where separate land uses cannot be mapped individually. Residential, Commercial, Industrial, and occasionally other land uses may be included. A mixture of industrial and commercial uses in Industrial and Commercial Complexes as defined in category 15 are not included in this category. Farmsteads intermixed with strip or cluster settlements will be included within the built-up land, but other agricultural land uses should be excluded.

17. OTHER URBAN OR BUILT-UP LAND

Other Urban or Built-up Land typically consists of uses such as golf driving ranges, zoos, urban parks, cemeteries, waste dumps, water-control structures and spillways, the extensive parts of such uses as golf courses and ski areas, and undeveloped land within an urban setting. Open land may be in very intensive use but a use that does not require structures, such as urban playgrounds, botanical gardens, or arboreta. The use of descriptions such as "idle land," "vacant land," or "open land" should be avoided in categorizing undeveloped lands within urban areas on the basis of the use of remote sensor data, since information generally is not available to the interpreter to make such a refinement in categorization.

2. AGRICULTURAL LAND

Agricultural Land may be defined broadly as land used primarily for production of food and fiber. On high-altitude imagery, the chief indications of agricultural activity will be distinctive geometric field and road patterns on the landscape and the traces produced by livestock or mechanized equipment. However, pasture and other lands where such equipment is used infrequently may not show as well-defined shapes as other areas. These distinctive geometric patterns are also characteristic of Urban or Built-up Lands because of street layout and development by blocks. Distinguishing between Agricultural and Urban or Built-up Lands ordinarily should be possible on the basis of urban-activity indicators and the associated concentration of population. The number of building complexes is smaller and the density of the road and highway network is much lower in Agricultural Land than in Urban or Built-up Land. Some urban land uses, such as parks and large cemeteries, however, may be mistaken for Agricultural Land, especially when they occur on the periphery of the urban areas.

The interface of Agricultural Land with other categories of land use may sometimes be a transition zone in which there is an intermixture of land uses at first and second levels of categorization. Where farming activities are limited by wetness, the exact boundary also may be difficult to locate, and Agricultural Land may grade into Wetland. When the production of agricultural crops is not hindered by wetland conditions, such cropland should be included in the Agricultural category. This latter stipulation also includes those cases in which agricultural crop production depends on wetland conditions, such as the flooding of ricefields or the development of cranberry bogs. When lands produce economic commodities as a function of their wild state such as wild rice, cattails, or certain forest products commonly associated with wetland, however, they should be included in the Wetland category. Similarly, when wetlands are drained for agricultural purposes, they should be included in the Agricultural Land category. When such drainage enterprises fall into disuse and if wetland vegetation is reestablished, the land reverts to the Wetland category.

The Level II categories of Agricultural Land are: Cropland and Pasture; Orchards, Groves, Vineyards, Nurseries, and Ornamental Horticultural Areas; Confined Feeding Operations; and Other Agricultural Land.

21. CROPLAND AND PASTURE

The several components of Cropland and Pasture now used for agricultural statistics include: cropland harvested, including bush fruits; cultivated summer-fallow and idle cropland; land on which crop failure occurs; cropland in soil-improvement grasses and legumes; cropland used only for pasture in rotation with crops; and pasture on land more or

less permanently used for that purpose. From imagery alone, it generally is not possible to make a distinction between Cropland and Pasture with a high degree of accuracy and uniformity, let alone a distinction among the various components of Cropland (Hardy, Belcher, and Phillips, 1971). Moreover, some of the components listed represent the condition of the land at the end of the growing season and will not apply exactly to imagery taken at other times of the year. They will, however, be a guide to identification of Cropland and Pasture. Brushland in the Eastern States, typically used to some extent for pasturing cattle, is included in the Shrub-Brushland Rangeland category since the grazing activity is usually not discernible on remote sensor imagery appropriate to Levels I and II. This activity possibly might be distinguished on low-altitude imagery. Such grazing activities generally occur on land where crop production or intensive pasturing has ceased, for any of a variety of reasons, and which has grown up in brush. Such brushlands often are used for grazing, somewhat analogous to the extensive use of rangelands in the West.

Certain factors vary throughout the United States, and this variability also must be recognized: field size depends on topography, soil types, sizes of farms, kinds of crops and pastures, capital investment, labor availability, and other conditions. Irrigated land in the Western States is recognized easily in contrast to Rangeland, but in the Eastern States, irrigation by use of overhead sprinklers generally cannot be detected from imagery unless distinctive circular patterns are created. Drainage or water control on land used for cropland and pasture also may create a recognizable pattern that may aid in identification of the land use. In areas of quick-growing crops, a field may appear to be in nonagricultural use unless the temporary nature of the inactivity is recognized.

22. ORCHARDS, GROVES, VINEYARDS, NURSERIES, AND ORNAMENTAL HORTICULTURAL AREAS

Orchards, groves, and vineyards produce the various fruit and nut crops. Nurseries and horticultural areas, which include floricultural and seed-and-sod areas and some greenhouses, are used perennially for those purposes. Tree nurseries which provide seedlings for plantation forestry also are included here. Many of these areas may be included in another category, generally Cropland and Pasture, when identification is made by use of small-scale imagery alone. Identification may be aided by recognition of the combination of soil qualities, topography, and local climatological factors needed for these operations: water bodies in close proximity which moderate the effects of short duration temperature fluctuations; site selection for air drainage on sloping land; and deep well-drained soils on slopes moderate enough to permit use of machinery. Isolated small orchards, such as the fruit trees on the family farm, usually are not recognizable on high-altitude imagery and are, therefore, not included.

23. CONFINED FEEDING OPERATIONS

Confined Feeding Operations are large, specialized livestock production enterprises, chiefly beef cattle feedlots, dairy operations with confined feeding, and large poultry farms, but also including hog feedlots. These operations have large animal populations restricted to relatively small areas. The result is a concentration of waste material that is an environmental concern. The waste-disposal problems justify a separate category for these relatively small areas. Confined Feeding Operations have a built-up appearance, chiefly composed of buildings, much fencing, access paths, and waste-disposal areas. Some are located near an urban area to take advantage of transportation facilities and proximity to processing plants.

Excluded are shipping corrals and other temporary holding facilities. Such occurrences as thoroughbred horse farms generally do not have the animal population densities which would place them in this category.

24. OTHER AGRICULTURAL LAND

Other land uses typically associated with the first three categories of Agricultural Land are the principal components of the Other Agricultural Land category. They include farmsteads, holding areas for livestock such as corrals, breeding and training facilities on horse farms, farm lanes and roads, ditches and canals, small farm ponds, and similar uses. Such occurrences generally are quite small in area and often uninterpretable by use of high-altitude data. Even when they are interpretable from such data, it may not be feasible to map them at smaller presentation scales, which generally results in their inclusion with adjacent agricultural use areas. This category should also be used for aggregating data for land uses derived at more detailed levels of classification.

3. RANGELAND

Rangeland historically has been defined as land where the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs and

where natural herbivory was an important influence in its precivilization state. Management techniques which associate soil, water, and forage-vegetation resources are more suitable for rangeland management than are practices generally used in managing pastureland. Some rangelands have been or may be seeded to introduced or domesticated plant species. Most of the rangelands in the United States are in the western range, the area to the west of an irregular north-south line that cuts through the Dakotas, Nebraska, Kansas, Oklahoma, and Texas. Rangelands also are found in certain places historically not included in the western range, such as the Flint Hills, the Southeastern States, and Alaska. The historical connotation of Rangeland is expanded in this classification to include those areas in the Eastern States which commonly are called brushlands.

The Level II categories of Rangeland are: Herbaceous Range, Shrub and Brush Rangeland, and Mixed Rangeland.

31. HERBACEOUS RANGELAND

The Herbaceous Rangeland category encompasses lands dominated by naturally occurring grasses and forbs as well as those areas of actual rangeland which have been modified to include grasses and forbs as their principal cover, when the land is managed for rangeland purposes and not managed using practices typical of pastureland. It includes the tall grass (or true prairie), short grass, bunch grass or palouse grass, and desert grass regions. Respectively, these grass regions represent a sequence of declining amounts of available moisture. Most of the tall grass region has been plowed for agriculture and the remaining tall grass range is now in North Dakota, Nebraska, southern Kansas and Oklahoma, and the Texas Coastal Plain. Short grass rangeland occurs in a strip about 300 miles (500 km) wide from the Texas Panhandle northward to the Dakotas where it widens to cover the western half of the Dakotas, the eastern three-fourths of Montana, and the eastern third of Wyoming. Bunch grass and desert grass are found in many locations, representing transitional situations to desert shrub. Typical occurrences of grasslands include such species as the various bluestems (*Andropogon*), grama grasses (*Bouteloua*), wheatgrasses (*Agropyron*), needlegrasses (*Stipa*), and fescues (*Festuca*).

This category also includes the palmetto prairie areas of south-central Florida, which consist mainly of dense stands of medium length and tall grasses such as wiregrass (*Aristida stricta*) and saw palmettos (*Seronoa ripens*), interspersed occasional palms (*Sabal palmetto*), and shrubs (Shelford, 1963). Those palmetto prairie areas now in improved pasture would not be included in this category, nor would the herbaceous varieties of tundra vegetation.

32. SHRUB AND BRUSH RANGELAND

The typical shrub occurrences are found in those arid and semiarid regions characterized by such xerophytic vegetative types with woody stems as big sagebrush (*Artemisia tridentata*), shadscale (*Atriplex confertifolia*), greasewood (*Sarcobatus vermiculatus*), or creosotebush (*Larrea divaricata*) and also by the typical desert succulent xerophytes, such as the various forms of *Cactus* (Kuchler, 1964). When bottom lands and moist flats are characterized by dense stands of typical wetland species such as mesquite (*Prosopis*), they are considered Wetland. Where highly alkaline soils are present, halophytes such as desert saltbush (*Atriplex*) may occur. The type, density, and association of these various species are useful as indicators of the local hydrologic and pedologic environments. Also included in this category are chaparral, a dense mixture of broadleaf evergreen schlerophyll shrubs, and the occurrences of mountain mahogany (*Cercocarpus ledifolius*) and scrub oaks (*Quercus*).

The eastern brushlands are typically former croplands or pasture lands (cleared from original forest land) which now have grown up in brush in transition back to forest land to the extent that they are no longer identifiable as cropland or pasture from remote sensor imagery. Many of these brushlands are grazed in an extensive manner by livestock and provide wildlife habitat. These areas usually remain as part of the farm enterprise, even though not being used at their former levels of intensity. Eastern brushland areas traditionally have not been included in the rangeland concept because of their original forested state prior to clearing for cropland or pasture and generally have been summarized statistically with pastureland. Because they function now primarily as extensive grazing land, they are included here as part of the Rangeland category. After sufficient forest growth has occurred, they should be classified as either Deciduous, Evergreen, or Mixed Forest Land. Those occurrences of shrubs and brush which are part of the Tundra are not included under Rangeland.

33. MIXED RANGELAND

When more than one-third intermixture of either herbaceous or shrub and brush rangeland species occurs in a specific area, it is classified as Mixed

Rangeland. Where the intermixed land use or uses total less than one-third of the specific area, the category appropriate to the dominant type of Rangeland is applied. Mixtures of herbaceous and shrub or brush tundra plants are not considered Rangeland.

4. FOREST LAND

Forest Lands have a tree-crown areal density (crown closure percentage) of 10 percent or more, are stocked with trees capable of producing timber or other wood products, and exert an influence on the climate or water regime. Forest Land generally can be identified rather easily on high-altitude imagery, although the boundary between it and other categories of land may be difficult to delineate precisely.

Lands from which trees have been removed to less than 10 percent crown closure but which have not been developed for other uses also are included. For example, lands on which there are rotation cycles of clearcutting and blockplanting are part of Forest Land. On such lands, when trees reach marketable size, which for pulpwood in the Southeastern United States may occur in 2 to 3 decades, there will be large areas that have little or no visible forest growth. The pattern can sometimes be identified by the presence of cutting operations in the midst of a large expanse of forest. Unless there is evidence of other use, such areas of little or no forest growth should be included in the Forest Land category. Forest land which is grazed extensively, as in the Southeastern States, would be included in this category because the dominant cover is forest and the dominant activities are forest related. Such activities could form the basis for Levels III or IV categorization. Lands that meet the requirements for Forest Land and also for an Urban or Built-up category should be placed in the latter category. The only exceptions in classifying Forest Land are those areas which would otherwise be classified as Wetland if not for the forest cover. Since the wet condition is of much interest to land managers and planning groups and is so important as an environmental surrogate and control, such lands are classified as Forested Wetland.

Auxiliary concepts associated with Forest Land, such as wilderness reservation, water conservation, or ownership classification, are not detectable using remote sensor data. Such concepts may be used for creating categories at the more detailed levels when supplemental information is available.

At Level II, Forest Land is divided into three categories: Deciduous, Evergreen, and Mixed. To differentiate these three categories effectively, sequential data, or at least data acquired during the period when deciduous trees are bare, generally will be necessary.

41. DECIDUOUS FOREST LAND

Deciduous Forest Land includes all forested areas having a predominance of trees that lose their leaves at the end of the frost-free season or at the beginning of a dry season. In most parts of the United States, these would be the hardwoods such as oak (*Quercus*), maple (*Acer*), or hickory (*Carya*) and the "soft" hardwoods, such as aspen (*Populus tremuloides*) (Shelford, 1963). Tropical hardwoods are included in the Evergreen Forest Land category. Deciduous forest types characteristic of Wetland, such as tupelo (*Nyssa*) or cottonwood (*Populus deltoides*), also are not included in this category.

42. EVERGREEN FOREST LAND

Evergreen Forest Land includes all forested areas in which the trees are predominantly those which remain green throughout the year. Both coniferous and broad-leaved evergreens are included in this category. In most areas, the coniferous evergreens predominate, but some of the forests of Hawaii are notable exceptions. The coniferous evergreens are commonly referred to or classified as softwoods. They include such eastern species as the longleaf pine (*Pinus palustris*), slash pine (*Pinus elliotii*), shortleaf pine (*Pinus echinata*), loblolly pine (*Pinus taeda*), and other southern yellow pines; various spruces (*Picea*) and balsam fir (*Abies balsamea*); white pine (*Pinus strobus*), red pine (*Pinus resinosa*), and jack pine (*Pinus banksiana*); and hemlock (*Tsuga canadensis*); and such western species as Douglas-fir (*Pseudotsuga menziesii*), redwood (*Sequoia sempervirens*), ponderosa pine (*Pinus monticola*), Sitka spruce (*Picea sitchensis*), Engelmann spruce (*Picea engelmanni*), western redcedar (*Thuja plicata*), and western hemlock (*Tsuga heterophylla*) (Shelford, 1963). Evergreen species commonly associated with Wetland, such as tamarack (*Larix laricina*) or black spruce (*Picea mariana*), are not included in this category (Kuchler, 1964).

43. MIXED FOREST LAND

Mixed Forest Land includes all forested areas where both evergreen and deciduous trees are growing and neither predominates. When more than one-third intermixture of either evergreen or deciduous species occurs in a specific area, it is classified as Mixed Forest Land. Where the intermixed land use

or uses total less than one-third of the specified area, the category appropriate to the dominant type of Forest Land is applied, whether Deciduous or Evergreen.

5. WATER

The delineation of water areas depends on the scale of data presentation and the scale and resolution characteristics of the remote sensor data used for interpretation of land use and land cover. (Water as defined by the Bureau of the Census includes all areas within the land mass of the United States that persistently are water covered, provided that, if linear, they are at least 1/8 mile (200 m) wide and, if extended, cover at least 40 acres (16 hectares) .) For many purposes, agencies need information on the size and number of water bodies smaller than Bureau of the Census minimums. These frequently can be obtained from small-scale remote sensor data with considerable accuracy.

51. STREAMS AND CANALS

The Streams and Canals category includes rivers, creeks, canals, and other linear water bodies. Where the water course is interrupted by a control structure, the impounded area will be placed in the Reservoirs category.

The boundary between streams and other bodies of water is the straight line across the mouth of the stream up to 1 nautical mile (1.85 km). Beyond that limit, the classification of the water body changes to the appropriate category, whether it be Lakes, Reservoirs, or Bays and Estuaries. These latter categories are used only if the water body is considered to be "inland water" and therefore included in the total area of the United States. No category is applied to waters classified as "other than inland water" or offshore marine waters beyond the mouths of rivers (U.S. Bureau of the Census, 1970).

52. LAKES

Lakes are nonflowing, naturally enclosed bodies of water, including regulated natural lakes but excluding reservoirs. Islands that are too small to delineate should be included in the water area. The delineation of a lake should be based on the areal extent of water at the time the remote sensor data are acquired.

53. RESERVOIRS

Reservoirs are artificial impoundments of water used for irrigation, flood control, municipal water supplies, recreation, hydroelectric power generation, and so forth. Dams, levees, other water-control structures, or the excavation itself usually will be evident to aid in the identification, although the water-control structures themselves and spillways are included in the Other Urban or Built-up Land category.

In most cases, reservoirs serve multiple purposes and may include all of the land use functions just mentioned. In certain cases like the Tennessee River, the entire length of the trunk stream is impounded. In such a situation, the stream exists as a stairstep series of impoundments with waterway, flood-control, recreation, and power-generation functions but is still considered a reservoir, since the additional functions are the result of impoundment.

54. BAYS AND ESTUARIES

Bays and Estuaries are inlets or arms of the sea that extend inland. They are included in this system only when they are considered to be inland water and therefore are included within the total area of the United States. Those bay and estuarine water areas classified as "other than inland water" are not included within the total area of the United States. These "other than inland water" areas are adjacent to certain States and fall under their jurisdiction. They occur in primary bodies of water such as the Atlantic Ocean coastal waters, Chesapeake Bay, Delaware Bay, Long Island Sound, Gulf of Mexico, Pacific Ocean coastal waters, Puget Sound, the Straits of Georgia and Juan de Fuca, Gulf of Alaska, Bering Sea, Arctic Ocean coastal waters, and the Great Lakes (U.S. Bureau of the Census, 1970). Only those bays and estuaries classified as inland water are included in this category. No category is applied to offshore waters beyond the limits of Bays and Estuaries.

6. WETLAND

Wetlands are those areas where the water table is at, near, or above the land surface for a significant part of most years. The hydrologic regime is such that aquatic or hydrophytic vegetation usually is established, although alluvial and tidal flats may be nonvegetated. Wetlands frequently are associated with topographic lows, even in mountainous regions. Examples of wetlands include marshes, mudflats, and swamps situated on the shallow margins of bays, lakes, ponds, streams, and manmade impoundments such as reservoirs. They include wet meadows or perched bogs in high mountain valleys and seasonally wet or flooded basins, playas, or potholes with no surface-water outflow. Shallow water areas

where aquatic vegetation is submerged are classed as open water and are not included in the Wetland category.

Extensive parts of some river flood plains qualify as Wetlands, as do regularly flooded irrigation overflow areas. These do not include agricultural land where seasonal wetness or short-term flooding may provide an important component of the total annual soil moisture necessary for crop production. Areas in which soil wetness or flooding is so short-lived that no typical wetlands vegetation is developed properly belong in other categories.

Cultivated wetlands such as the flooded fields associated with rice production and developed cranberry bogs are classified as Agricultural Land. Uncultivated wetlands from which wild rice, cattails, or wood products, and so forth are harvested, or wetlands grazed by livestock, are retained in the Wetland category.

Remote sensor data provide the primary source of land use and vegetative cover information for the more generalized levels of this classification system. Vegetation types and detectable surface water or soil moisture interpreted from such data provide the most appropriate means of identifying wetlands and wetland boundaries. Inasmuch as vegetation responds to changes in moisture conditions, remote sensor data acquired over a period of time will allow the detection of fluctuations in wetland conditions. Ground surveys of soil types or the duration of flooding may provide supplemental information to be employed at the more detailed levels of classification.

Wetland areas drained for any purpose belong to other land use and land cover categories such as Agricultural Land, Rangeland, Forest Land, or Urban or Built-up Land. When the drainage is discontinued and such use ceases, classification may revert to Wetland. Wetlands managed for wildlife purposes may show short-term changes in land use as different management practices are used but are properly classified Wetland.

Two separate boundaries are important with respect to wetland discrimination: the upper wetland boundary above which practically any category of land use or land cover may exist, and the boundary between wetland and open water beyond which the appropriate Water category should be employed.

Forested Wetland and Nonforested Wetland are the Level II categories of Wetland.

61. FORESTED WETLAND

Forested Wetlands are wetlands dominated by woody vegetation. Forested Wetland includes seasonally flooded bottomland hardwoods, mangrove swamps, shrub swamps, and wooded swamps including those around bogs. Because Forested Wetlands can be detected and mapped by the use of seasonal (winter/summer) imagery, and because delineation of Forested Wetlands is needed for many environmental planning activities, they are separated from other categories of Forest Land.

The following are examples of typical vegetation found in Forested Wetland. Wooded swamps and southern flood plains contain primarily cypress (*Taxodium*), tupelo (*Nyssa*), oaks (*Quercus*), and red maple (*Acer rubrum*). Mangroves (*Avicennia* and *Rhizophora*) are dominant in certain subtropical Forested Wetland areas. Central and northern flood plains are dominated by cottonwoods (*Populus*), ash (*Fraxinus*), alder (*Alnus*), and willow (*Salix*). Flood plains of the Southwest may be dominated by mesquite (*Prosopis*), saltcedar (*Tamarix*), seepwillow (*Baccharis*), and arrowweed (*Pluchea*). Northern bogs typically contain tamarack or larch (*Larix*), black spruce (*Picea mariana*), and heath shrubs (*Ericaceae*). Shrub swamp vegetation includes alder (*Alnus*), willow (*Salix*), and buttonbush (*Cephalanthus occidentalis*).

62. NONFORESTED WETLAND

Nonforested Wetlands are dominated by wetland herbaceous vegetation or are nonvegetated. These wetlands include tidal and nontidal fresh, brackish, and salt marshes and nonvegetated flats and also freshwater meadows, wet prairies, and open bogs.

The following are examples of vegetation associated with Nonforested Wetland. Narrow-leaved emergents such as cordgrass (*Spartina*) and rush (*Juncus*) are dominant in coastal salt marshes. Both narrow-leaved emergents such as cattail (*Typha*), bulrush (*Scirpus*), sedges (*Carex*), sawgrass (*Cladium*) and other grasses (for example, *Panicum* and *Zizaniopsis miliacea*), and broad-leaved emergents such as waterlily (*Nuphar, Nymphea*), pickerelweed (*Pontederia*), arrow arum (*Peltandra*), arrowhead (*Sagittaria*), water hyacinth (*Eichhornia crassipes*), and alligatorweed (*Alternanthera philoxeroides*) are typical of brackish to freshwater locations. Mosses (*Sphagnum*) and sedges (*Carex*) grow in wet meadows and bogs.

7. BARREN LAND

Barren Land is land of limited ability to support life and in which less than one-third of the area has vegetation or other cover. In general, it is an area of thin soil, sand, or rocks. Vegetation, if present, is more widely spaced and scrubby than that in the

Shrub and Brush category of Rangeland. Unusual conditions, such as a heavy rainfall, occasionally result in growth of a short-lived, more luxuriant plant cover. Wet, nonvegetated barren lands are included in the Nonforested Wetland category.

Land may appear barren because of man's activities. When it may reasonably be inferred from the data source that the land will be returned to its former use, it is not included in the Barren category but classified on the basis of its site and situation. Agricultural land, for example, may be temporarily without vegetative cover because of cropping season or tillage practices. Similarly, industrial land may have waste and tailing dumps, and areas of intensively managed forest land may have clear-cut blocks evident.

When neither the former nor the future use can be discerned and the area is obviously in a state of land use transition, it is considered to be Barren Land, in order to avoid inferential errors.

Level II categories of Barren Land are: Dry Salt Flats, Beaches, Sandy Areas other than Beaches; Bare Exposed Rock; Strip Mines, Quarries, and Gravel Pits; Transitional Areas; and Mixed Barren Land.

71. DRY SALT FLATS

Dry Salt Flats occurring on the flat-floored bottoms of interior desert basins which do not qualify as Wetland are included in this category. On aerial photographs, Dry Salt Flats tend to appear white or light toned because of the high concentrations of salts at the surface as water has been evaporated, resulting in a higher albedo than other adjacent desert features.

72. BEACHES

Beaches are the smooth sloping accumulations of sand and gravel along shorelines. The surface is stable inland, but the shoreward part is subject to erosion by wind and water and to deposition in protected areas.

73. SANDY AREAS OTHER THAN BEACHES

Sandy Areas other than Beaches are composed primarily of dunes—accumulations of sand transported by the wind. Sand accumulations most commonly are found in deserts although they also occur on coastal plains, river flood plains, and deltas and in periglacial environments. When such sand accumulations are encountered in tundra areas, they are not included here but are placed in the Bare Ground Tundra category.

74. BARE EXPOSED ROCK

The Bare Exposed Rock category includes areas of bedrock exposure, desert pavement, scarps, talus, slides, volcanic material, rock glaciers, and other accumulations of rock without vegetative cover, with the exception of such rock exposures occurring in tundra regions.

75. STRIP MINES, QUARRIES, AND GRAVEL PITS

Those extractive mining activities that have significant surface expression are included in this category. Vegetative cover and overburden are removed to expose such deposits as coal, iron ore, limestone, and copper. Quarrying of building and decorative stone and recovery of sand and gravel deposits also result in large open surface pits. Current mining activity is not always distinguishable, and inactive, unreclaimed, and active strip mines, quarries, borrow pits, and gravel pits are included in this category until other cover or use has been established, after which the land would be classified in accordance with the resulting use or cover. Unused pits or quarries that have been flooded, however, are placed in the appropriate Water category.

76. TRANSITIONAL AREAS

The Transitional Areas category is intended for those areas which are in transition from one land use activity to another. They are characterized by the lack of any remote sensor information which would enable the land use interpreter to predict reliably the future use or discern the past use. All that actually can be determined in these situations is that a transition is in progress, and inference about past or future use should be avoided. This transitional phase occurs when, for example, forest lands are cleared for agriculture, wetlands are drained for development, or when any type of land use ceases as areas become temporarily bare as construction is planned for such future uses as residences, shopping centers, industrial sites, or suburban and rural residential subdivisions. Land being altered by filling, such as occurs in spoil dumps or sanitary landfills, also is indicative of this transitional phase.

77. MIXED BARREN LAND

The Mixed Barren Land category is used when a mixture of Barren Land features occurs and the dominant land use occupies less than two-thirds of the area. Such a situation arises, for example, in a desert region where combinations of salt flats, sandy areas, bare rock, surface extraction, and transi-

tional activities could occur in close proximity and in areal extent too small for each to be included at mapping scale. Where more than one-third intermixture of another use or uses occurs in a specific area, it is classified as Mixed Barren Land. Where the intermixed land use or uses total less than one-third of the specific area, the category appropriate to the dominant type of Barren Land is applied.

8. TUNDRA

Tundra is the term applied to the treeless regions beyond the limit of the boreal forest and above the altitudinal limit of trees in high mountain ranges. In the United States, tundra occurs primarily in Alaska, in several areas of the western high mountain ranges, and in small isolated locations in the higher mountains of New England and northern New York. The timber line which separates forest and tundra in alpine regions corresponds to an arctic transition zone in which trees increasingly are restricted to the most favorable sites.

The vegetative cover of the tundra is low, dwarfed, and often forms a complete mat. These plant characteristics are in large part the result of adaptation to the physical environment—one of the most extreme on Earth, where temperatures may average above freezing only 1 or 2 months out of the year, where strong desiccating winds may occur, where great variation in solar energy received may exist, and where permafrost is encountered almost everywhere beneath the vegetative cover.

The number of species in the tundra flora is relatively small compared with typical middle- and low-latitude flora, and this number of species decreases as the environment becomes increasingly severe with changes of latitude and altitude. The tundra vegetation consists primarily of grasses, sedges, small flowering herbs, low shrubs, lichens, and mosses. The vegetative cover is most luxuriant near the boreal forest, with the ground surface usually being completely covered. As the plant cover becomes sparse, shrubs become fewer and more bare areas occur. Species diversity is lowest near the boundaries of permanent ice and snow areas, where only isolated patches of vegetation occur on the bare ground surface.

The vegetation of the tundra is closely associated with other environmental factors. Minor manmade disturbances, as well as microenvironmental changes over short distances, can have significant effects. Minor changes in available moisture or wind protection, for example, can result in different plant associations. Similarly, man's activity in the tundra may engender new drainage patterns with resultant changes in plant community or erosion characteristics (Price, 1972).

The boundaries between Tundra, Perennial Snow or Ice, and Water are best determined by using images acquired in late summer. The Forest Land-Tundra boundary in the Arctic tends to be transitional over a wide area and characterized by either incursion of forests where site improvement occurs, as along the flood plains or river valleys, or by increasing environmental severity, as on exposed dry uplands. This Forest Land-Tundra boundary is much easier to delineate in alpine areas. The Barren Land-Tundra interface occurs where one or more of the environmental parameters necessary for vegetation growth is deficient and also would be determined best with late-summer imagers.

Using the results of various investigations, Level II categories of Tundra based primarily on what is interpretable from remote sensor image signatures are: Shrub and Brush Tundra, Herbaceous Tundra, Bare Ground Tundra, Wet Tundra, and Mixed Tundra.

81. SHRUB AND BRUSH TUNDRA

The Shrub and Brush Tundra category consists of the various woody shrubs and brushy thickets found in the tundra environment. These occur in dense-to-open evergreen and deciduous thickets, with the latter dominated by types such as the various birches (*Betula*), alders (*Alnus*), or willows (*Salix*), as well as many types of berry plants. Low evergreen shrub thickets are characterized by such dominant types as *Empetrum* and various members of the heath family, such as *Cassiope*, *Vaccinium*, and *Ledum* (Viereck and Little, 1972).

82. HERBACEOUS TUNDRA

Herbaceous Tundra is composed of various sedges, grasses, forbs, lichens, and mosses, all of which lack woody stems. A wide variety of such herbaceous types may be found in close proximity on the tundra. Sites having sufficient moisture usually are covered with a thick mat of mosses together with sedges such as *Carex* and *Eriophorum* (cotton grass) in almost continuous and uniform tussocks, as well as other herbaceous forms such as types of bluegrass (*Poa*), buttercups (*Ranunculus*), and lichens such as *Cladonia* and *Cetraria*. Drier or more exposed sites usually trend toward a sparse moss-lichen mat.

83. BARE GROUND TUNDRA

The Bare Ground Tundra category is intended for those tundra occurrences which are less than one-

third vegetated. It usually consists of sites visually dominated by considerable areas of exposed bare rock, sand, or gravel interspersed with low herbaceous and shrubby plants. This type of tundra is indicative of the most severe environmental stress and usually occurs poleward of the areas supporting the more luxuriant herbaceous and shrub forms and on higher mountain ridges. The various species of *Dryas*, such as white mountain-avens, are dominant in Arctic regions, as are the sandworts (*Minuartia*) and mountainheaths (*Phyllodoce*). Bare Ground Tundra gradually merges with one or more of the Barren Land categories on its more severe margin.

84. WET TUNDRA

Wet Tundra is usually found in areas having little topographic relief. Standing water is almost always present during months when temperatures average above the freezing level. Numerous shallow lakes are also common (Joint Federal-State Land Use Planning Commission for Alaska, 1973). Permafrost is usually close to the surface, and various patterned ground features may be evident. Sedges (*Carex*) such as cotton grass are characteristically dominant, and a few shrubby plants may occur on adjacent drier sites. Rooted aquatic plants are also common. Wet Tundra is delineated best on imagery acquired in late summer.

85. MIXED TUNDRA

The Mixed Tundra category is used for a mixture of the Level II Tundra occurrences where any particular type occupies less than two-thirds of the area of the mapping unit. Where more than one-third intermixture of another use or uses occurs in a specific area, it is classified as Mixed Tundra. Where the intermixed land cover categories total less than one-third of the specific area, the category appropriate to the dominant type of Tundra is applied.

9. PERENNIAL SNOW OR ICE

Certain lands have a perennial cover of either snow or ice because of a combination of environmental factors which cause these features to survive the summer melting season. In doing so, they persist as relatively permanent features on the landscape and may be used as environmental surrogates. Snow, firn (coarse, compacted granular snow), or ice accumulation in these areas exceeds ablation, which is the combined loss of snow or ice mass by evaporation and melt-water runoff. Adjacent lands most commonly will be classed as Water, Wetland, Barren Land, or Tundra, with their common boundaries being distinguished most readily on late summer imagery.

The terminology and nomenclature of any subdivision of Perennial Snow or Ice areas are always subject to considerable debate, but a Level II breakdown into categories of Perennial Snowfields and Glaciers seems to be appropriate for use with remote sensor data. Such a subdivision is based on surface form and the presence or absence of features indicating glacial flow. In addition, these forms and flow features may be related to stage of development and certain periglacial or glacial processes.

91. PERENNIAL SNOWFIELDS

Perennial Snowfields are accumulations of snow and firn that did not entirely melt during previous summers. Snowfields can be quite extensive and thus representative of a regional climate, or can be quite isolated and localized, when they are known by various terms, such as snowbanks.

The regional snowline is controlled by general climatic conditions and closely parallels the regional 32°F (0°C) isotherm for the average temperature of the warmest summer month. The use of the term "line" is somewhat misleading, because the "snowline" represents an irregular transitional boundary, which is determined at any single location by the combination of snowfall and ablation, variables which can change greatly within short distances because of changes in local topography and slope orientation.

Small isolated snowfields occurring in protected locations can develop into incipient or nivation cirques, which become gradually hollowed by the annual patterns of freezing and thawing, aided by downslope movement of rock material. They are circular to semicircular and often develop ridges of mass-wasted materials called protalus ramparts at their downslope margins. As Flint (1957) has pointed out, "Such cirques, of course, are not in themselves indication of glaciation, they indicate merely a frost climate."

Snowfields can normally be distinguished from the following Glacier category by their relative lack of flow features.

92. GLACIERS

Glacial ice originates from the compaction of snow into firn and finally to ice under the weight of several successive annual accumulations. Refrozen melt water usually contributes to the increasing density of the glacial ice mass. With sufficient thickness,

weight, and bulk, flow begins, and all glaciers exhibit evidence of present or past motion in the form of moraines, crevasses, and so forth.

Where the snowline of adjacent ice-free areas extends across the glacier, it is known as the firn limit, which represents the dividing line between the glacier's two major zones, the zone of accumulation and the zone of ablation. While glaciers normally are recognized easily, certain glacial boundaries may be subject to misinterpretation, even by the experienced interpreter. Flow features upglacier from the firn limit typically are obscured by fresh snow, forcing the image interpreter to depend on secondary information such as valley shape or seek a more discriminating sensor. Similarly, morainal material may cover the terminus (or snout) of the glacier because of ablation, making boundary determination in that vicinity difficult. This latter problem occasionally is compounded by the presence of considerable vegetation rooted in the insulating blanket of ablation moraine.

Further subdivision of glacial occurrences, mainly on the basis of form and topographic position, would include: small drift glaciers (sometimes called Ural-type or cirque glaciers); valley glaciers (also called mountain or alpine glaciers); piedmont glaciers; and icecaps (or ice sheets).

Other features have somewhat the surface form of true glaciers, such as "rock glaciers." Since these are composed primarily of fragmented rock material together with interstitial ice, they are classified as Bare Exposed Rock.

MAP PRESENTATION

Figures 1 through 4 depict typical maps which have been produced using the U.S. Geological Survey land use and land cover classification system. The land use and land cover maps have been produced by conventional interpretation techniques and are typical examples of maps produced from high-altitude color-infrared photographs.

In order to provide a systematic and uniform approach to the presentation of land use and land cover information in map format, a scheme of color coding is employed (table 4). In this scheme, Level I land uses are color coded using a modified version of the World Land Use Survey (International Geographical Union, 1952) color scheme. Level II land uses can be presented using the two-digit numeral appropriate to the land use category, such as "21," which would signify Cropland and Pasture. The use of some type of system other than a further stratification by color is necessary at Level II since it would be a considerable problem to select 37 different colors which would be distinguishable at the size of the minimum mapping unit. A numerical system, with the number of digits equaling the level of categorization, forms a flexible classification system that permits continuation to Levels III and IV or beyond. In addition, retaining a discrete color code for each Level I land use or land cover category permits rapid visual integration of the areas characterized by that use or cover type.

TABLE 4.—*U.S.G.S. Level I Land Use Color Code*

1.	Urban or Built-up Land	Red (Munsell 5R 6/12).
2.	Agricultural Land	Light Brown (Munsell 5YR 7/4).
3.	Rangeland	Light Orange (Munsell 10YR 9/4).
4.	Forest Land	Green (Munsell 10GY 8/5).
5.	Water	Dark Blue (Munsell 10B 7/7).
6.	Wetland	Light Blue (Munsell 7.5B 8.5/3).
7.	Barren Land	Gray (Munsell N 8/0).
8.	Tundra	Green-Gray (Munsell 10G 8.5/1.5).
9.	Perennial Snow or Ice	White (Munsell N 10/0).

Even though a numerical system for the Level II land uses has been illustrated, such a system is not the only method of presenting Level II land use information. What is proposed is the use of the modified International Geographical Union World Land Use Survey color code at Level I. Alternatives to a numerical code at Level II could take the form of graphic symbols such as dots, stipples, cross-hatching, swamp or marsh symbols, or any of the great variety of such items available to the cartographer. Such a method, together with the Level I color coding, would allow the reader rapid visual orientation to each discrete Level II land use category but would impede statistical inventory of the area included in each land use and would be difficult to subdivide further into Level III categories.

Another alternative for land use symbolization at Level II is the use of an alphabetical code for each category such as "Ur," representing (Urban or Built-up) Residential Land, or "Ac," for (Agricultural) Cropland and Pasture. Such a system has the merit of suggesting the logical name of each category but also impedes interpretation and enumeration at the more detailed levels because of increased complexity of the alphabetical code. In addition, the increase in length of the alphabetical code used for the more detailed levels will cause placement problems as the minimum size of a mapping unit is approached.

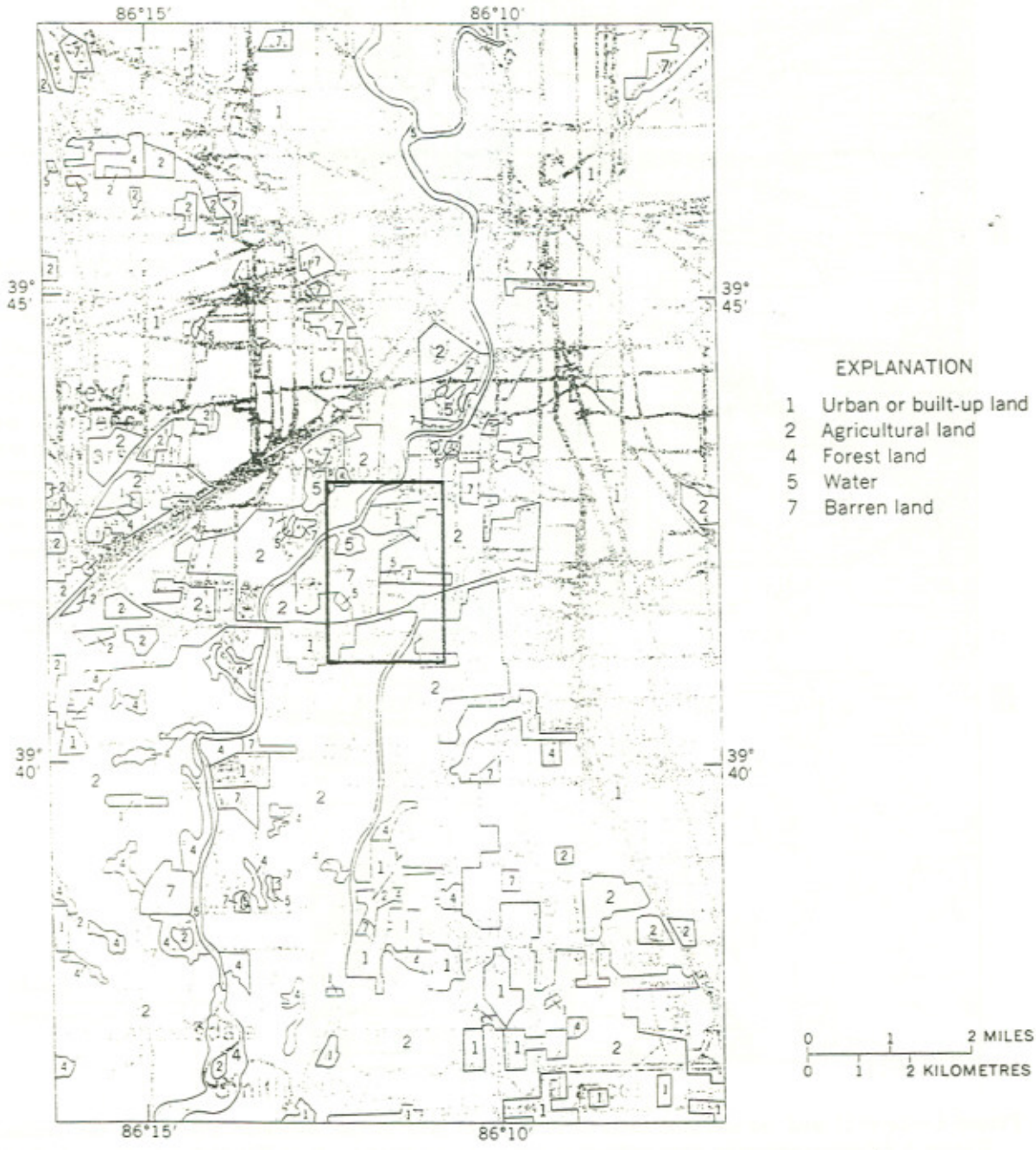


FIGURE 1.—Level I land use and land cover in an enlarged part of the northeast quarter of the Indianapolis, Indiana-Illinois, 1:250,000 quadrangle. Area outlined in center of map corresponds to Maywood area shown in figures 3 and 4.

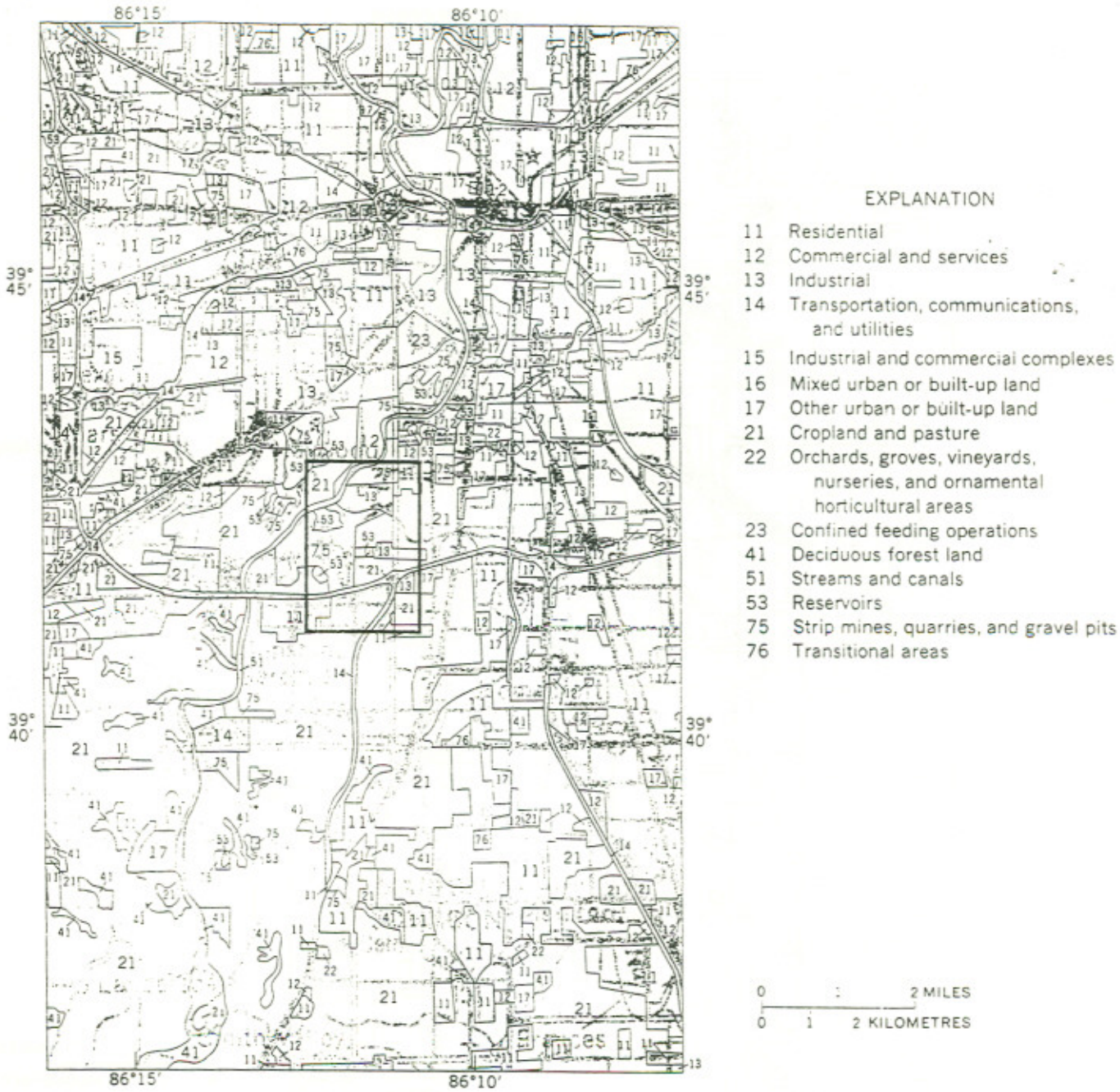
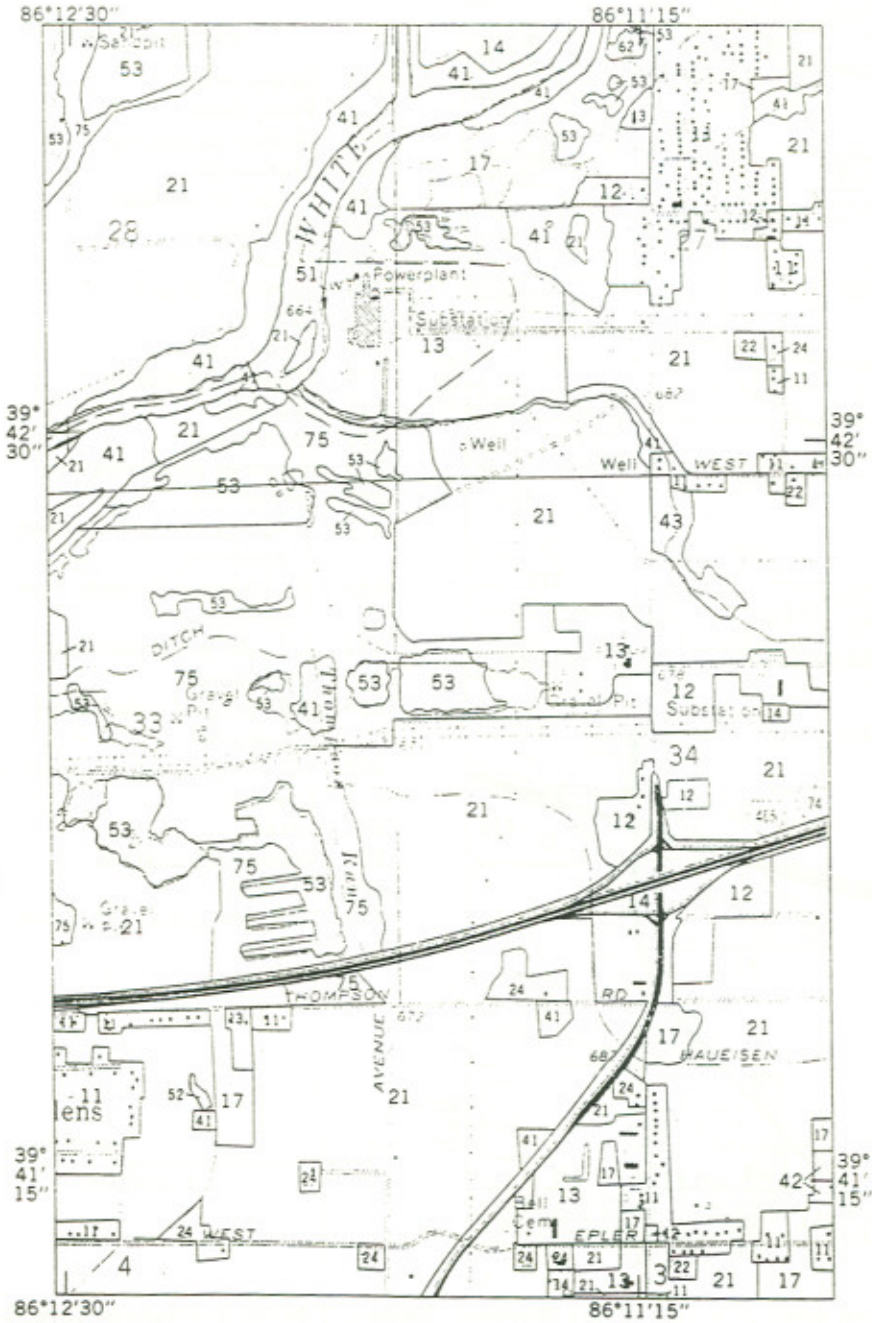


FIGURE 2.—Level II land use and land cover in an enlarged part of the northeast quarter of the Indianapolis, Indiana-Illinois, 1:250,000 quadrangle. Area outlined in center of map corresponds to Maywood area shown in figures 3 and 4.



EXPLANATION

11	Residential
12	Commercial and services
13	Industrial
14	Transportation, communications, and utilities
17	Other urban or built-up land
21	Cropland and pasture
22	Orchards, groves, vineyards, nurseries, and ornamental horticultural areas
24	Other agricultural land
41	Deciduous forest land
42	Evergreen forest land
43	Mixed forest land
51	Streams and canals
52	Lakes
53	Reservoirs
62	Nonforested wetland
75	Strip mines, quarries, and gravel pits

FIGURE 3.—Level II land use and land cover in a part of the Maywood, Indiana, 1:24,000 quadrangle. Level III interpretations for the same area are shown in figure 4.

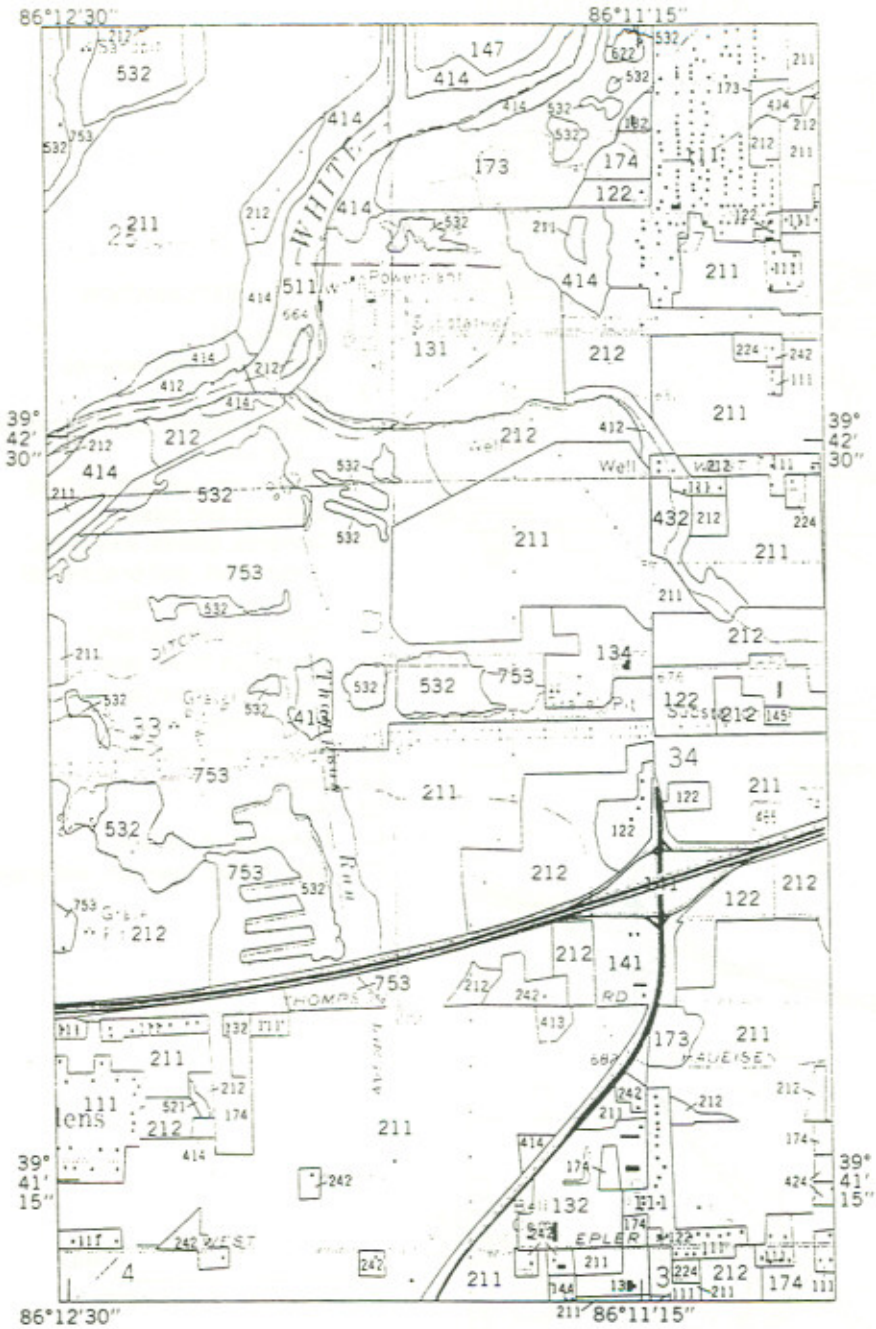


FIGURE 4.—Level III land use and land cover in a part of the Maywood, Indiana, 1:24,000 quadrangle. Level II interpretations for the same area are shown in figure 3.

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APPENDIX C

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